M. BLVNDEVILE
His Exerciſes, containing

eight Treatiſes, the titles whereof are ſet downe *in the next printed page: which Treatiſes are verie* neceſſarie to be read and learned of all yoong Gentlemen *that haue not bene exerciſed in ſuch diſciplines*, and yet are deſirous to haue knowledge as well in Coſmographie, *Aſtronomie, and Geographie, as alſo in the* Arte of Nauigation, in which Arte it is impoſſible to profite without the helpe of theſe, or ſuch like inſtructions.

To the furtherance of which Arte of Nauigation, the ſaid *M.* Blundeuile *ſpecially wrote the ſaid Treatiſes, and of meere* goodwill doth Dedicate the ſame to all young Gentlemen of this Realme.

The ſecond edition, Corrected and aug*mented by the Author.*



Imprinted at London by *Iohn Windet*, dwelling at the ſigne of the Croſſe Keyes, neere Paules Wharffe, and are there to be ſolde. 1597.

The Titles of the Treatiſes contained in this Booke.

FIrſt, a very eaſie Arithmeticke ſo plainely written as any man of a meane capacitie may eaſily learn the ſame without the helpe of any teacher.

Item the firſt principles of Coſmographie, and eſpecially a plaine treatiſe of the Spheare, repreſenting the ſhape of the whole world, together with the chiefeſt and moſt neceſſarie vſes of the ſaid Spheare.

Item a plaine and full deſcription of both the Globes, as well Terreſtriall as Celeſtiall, and all the chiefeſt & moſt neceſſarie vſes of the ſame, in the ende whereof are ſet downe the chiefeſt vſes of the Ephemerides of *Iohannes Stadius*, and of certaine neceſſarie Tables therein contayned for the better finding out of the true place of the Sun and Moone, and of all the reſt of the Planets vpon the Celeſtiall Globe.

Item a plaine and full deſcription of *Petrus Plancius* his vniuerſall Mappe, lately ſet forth in the yeare of our Lord 1592. containing more places newly found, as well in the Eaſt and Weſt Indies, as alſo towards the North Pole, which no other Map made heretofore hath, wherevnto

is also added how to finde out the true distance betwixt any two places on the land or sea, their Longitudes and latitudes being first knowne, and thereby you may correct the skales or Tronkes, that be not truely set downe in any Map or Carde.

Item, Abriefe and plaine description of M. *Blagraue* his Astrolabe, otherwise called the Mathematicall Iewell, shewing the most necessarie vses thereof, and meetest for sea men to know.

Item the first & chiefest principles of Nauigation more plainely and more orderly taught then they haue beene heretofore by some that haue written thereof, lately collected out of the best modern writers, and treaters of that Arte.

Item a briefe description of vniuersall Maps & Cardes, and of their vse: And also the vse of *Ptolomie* his Tables together with the true order of making the said Tables. And of all other Maps and Cardes as well vniuersall as particular, and that according to the doctrine of the best Geographers that be or haue beene in these latter dayes.

Item the true order of making of *Ptolomie* his Tables & also the making of all other Tables, Maps or Cardes as wel vniuersall as particular and that according to the doctrine of the best Geographers that be or haue beene in these later dayes.

And moreouer, I haue thought good to adv nto mine Arithmeticke, as an appendix depending thereon, the vse of the Tables of the three right lines belonging to a Circle, which lines are called Sines, lines Tangent, and lines Secant.

cant, whereby many profitable and neceſſarie concluſions as well of Aſtronomie, as of Geometrie are to bee wrought onely by the helpe of Arithmeticke, which Tables are ſet downe by *Clauius* the Ieſuite, a moſt excellent Mathematician, in his Booke of demonſtrations made vpon the Spherickes of *Theodoſius*, more truely printed than thoſe of *Monte Regio*, which booke whileſt I read at mine owne houſe, together with a louing friend of mine, I took ſuch delight therein, as I mind (God willing) if God giue mé life, to tranſlate all thoſe propoſitions, which *Clauius* himſelfe hath ſet downe of his owne, touching the quantitie of Angles, and of their ſides, as well in right line triangles, as in Sphericall triangles: of which matter, as *Monte Regio* wrote diffuſedly and at large, ſo *Copernicus* wrote of the ſame briefly, but therewith ſomewhat obſcurely, as *Clauius* ſaith. Moreouer, in reading the Geometrie of *Albertus Durerus*, that excellent painter, and finding many of his concluſions very obſcurely interpreted by his Latine interpreter (for hee himſelfe wrote in high Dutch) I requeſted a friend of mine, whome I knewe to haue ſpent ſome time in the ſtudy of the Mathematicals, not onelye plainely to tranſlate the foreſaid *Durerus* into Engliſh, but alſo to adde therunto many neceſſarie propoſitions of his owne, which my requeſt he hath (I thanke him) very wel perfourmed, not onely to my ſatisfaction, but alſo to the great commoditie and profite of all thoſe that deſire to be perfect in Architecture, in the Arte of Painting, in free Maſons craft, in Ioyners craft, in Caruers craft, or any ſuch like Arte commodious and ſeruiceable in any common Wealth, and I hope that hee will put the ſame in print ere it be long, his name I conceale at his owne eameſt intreatie, although much againſt my will, but I hope that hee

will make himselfe knowne in the publishing of his Arithmeticke, and the great Arte of *Algebra*, the one being almost finished, & the other to be vndertaken at his best leasure, as also in the printing of *Durerus*, vnto whom he hath added manye necessarie Geometricall conclusions, not heard of heeretofore, together with diuers other of his workes as well in Geometrie as in other of the Mathematicall sciences, if he bee not called away from these his studies by other affaires. In the meane time I pray all young Gentlemen and seamen to take these my labours alreadie ended in good part, wherby I seeke neither praise nor glorie, but onely to profite my countrie.

To

To the Reader.

I Greatly reioyce to see so many of our English Gentlemen, both of the Court & Countrie in these dayes so earnestly giuen to trauell as well by sea as land, into strange and vnknowne countries; and specially into the East and West Indies following therein the good example of diuers worthie knights & Gentlmen that haue ventured their liues to discouer strange countries to the great honour of their countrie, and to their owne immortall fame. And because that to trauell by sea requireth skil in the Art of Nauigation, in which it is vnpossible for any man to be perfect vnlesse he first haue his Arithmeticke and also some knowledge in the principles of Cosmographie, & specially to haue the vse of the Spheare, of the two Globes, of the Astrolabe, and crosse staffe, and such like instruments belonging to the Art of Nauigation, I thought good therefore to write the Treatises before mentioned, to serue as an introduction for such young Gentlemen as haue not beene exercised in such kind of studies, which Treatises if they shall vouchsafe to reade with attentiue minde, and in such order as they are before set downe, I doubt not but that it will cause them hereafter to seeke for further knowledge therein. And in any wise I wish them to begin with my Arithmeticke, the contents whereof are declared in the next Chapter following. In the meane time I doe earnestly request all young Gentlemen to take these my simple pamphlets no lesse thankfully than they haue done my horse booke, and in so doing I shall haue iust cause to thinke my labour well bestowed.

What

TO

What cauſe firſt mooued the Author to write this Arithmeticke, and with what order it is heere taught, which order the contents of the chapters therof hereafter following doe plainly ſhew.

I Began this Arithmeticke more than ſeuen yeares ſince for a vertuous Gentlewoman, and my very deare friend M. Elizabeth Bacon, the daughter of Sir Nicholas Bacon Knight, a man of moſt excellent wit, and of moſt deepe iudgement, and ſomtime Lord keeper of the great ſeale of England, and lately (as ſhee hath beene many yeares paſt) the moſt louing and faithfull wife of my worſhipfull friend M. Iuſtice Wyndham, not long ſince deceaſed, who for his integritie of life, and for his wiſedome and iuſtice dayly ſhewed in gouernment, and alſo for his good hoſpitalitie deſerued great commendation. And though at her requeſt I had made this Arithmeticke ſo playne and eaſie as was poſsible (to my ſeeming) yet her continuall ſickeneſſe woulde not ſuffer her to exerciſe her ſelfe therein. And becauſe that diuers hauing ſeene it, and liking my playne order of teaching therein, were deſirous to haue Copies thereof, I thought good therefore to print the ſame, and to augment it with many neceſſarie rules meete for thoſe that are deſirous to ſtudie any part of Coſmographie, Aſtronomie, or Geographie, and ſpeciallie the Arte of Nauigation, in which without Arithmeticke, as I haue ſaide before, they ſhall hardly profite. But nowe to returne to my mat-

matter, the contents of this Arithmeticke are these here following. First, hauing defined what Arithmeticke is, and what numeration or numbering is, and of what parts it consisteth, & how to number any great summe written in many figures, I deale with the foure speciall kindes of Arithmeticke, that is, Addition, Subtraction, Multiplication, and Diuision. Then I shew the order of working in whole numbers, called in Latine Integra, by the rule of Proportion, otherwise called the golden rule, or the rule of three: Then I treate of broken numbers called Fractions, setting downe seuen necessarie rules belonging thereunto, by the helpe whereof you shall be the better able to adde, subtract, to multiply and diuide the same. That done, I shew how to vse the rule of three as well in dealing with sole fractions as with Fractions annexed to Integrums, which rule of three is threefold, that is, the common rule, the rule reuerse, and the double rule, the order of all which three kindes I doe plainely teach by examples shewing wherein, how, and when, they are to be vsed. Next to that I set downe the rule of fellowship, a necessarie rule for those that haue to traffique in anye trade of Marchandize, giuing diuers examples thereof. Next to that I treate of Arithmeticall, and Geometricall Progression, and also of Proportion, and of the three kindes thereof, that is, of Proportion Arithmeticall, Geometricall, and Musicall. Then I shew how to finde out the square roote of any number, and also the vse thereof in setting of Battels, and also how to find out the cubique roote of any number. And last of all I treate of Astronomicall fractions, shewing how to adde, to subtract, to multiply and diuide the same. And also to take the square roote thereof, without the knowledge of which Fractions, you can neuer calculate any thinge truely out of the Astronomicall Tables.

Some perhaps do looke here that I should speake somwhat of the rules of Algebra, whereby all subtill and intricate questions of Arithmeticke are to bee vnfolded, wherewith I leaue indeede

deale, partly, for that I haue not of long time exercised my selfe therein, and partly because I knowe that one hath begun to write thereof, whose Booke being once ended, I doubt not but that hee will shortly after print the same to the great profit & furtherance of all those that delight in such good exercises. But in the meane time I haue thought good to adde (as I haue saide before) vnto this Arithmeticke a plaine description, together with the vse of the Table of Sines, of lines Tangent and Secant, which Tables will pleasure many that would gladlie know how and wherein to vse them, and specially such seamen as haue some taste of Arithmeticke, without the which no good almost is to bee done in anie science.

This

This Treatise of Arithmeticke contaiineth 26. Chapters as followeth.

WHat Arithmeticke is, what Numeration is, and of what partes it consisteth, and what signification euery digit hath according to his place, and how to expresse or tell a great number written in many figures. Chapter. 1.

Of the foure speciall kinds of Arithmeticke, and first of Addition, with examples thereof. Chap. 2.

Of Subtraction, with examples thereof, and how to trie the same. Chap. 3.

Of Multiplication and certaine Tables belonging thereunto, together with the vse thereof, and what is to be obserued therein, with examples and triall thereof. Chap. 4.

Of Diuision, and what is to be obserued therein, with examples and triall thereof, and of halfing any number. Chap. 5.

Of the rule of three, called the Golden rule, and what order is to be obserued in working thereby, and of the three kinds thereof. Chap. 6.

Of Fractions what they be, with a Demonstration thereof, together with seuen necessarie rules belonging to the same, & what euery rule teacheth. Chap. 7.

Of Addition, Subtraction, Multiplycation, and Diuision of Fractions. Chap. 8.

Of the common rule of three belonging to Fractions with examples. 9

Of

Of the rule reuerſe, called in Latine Regula euerſa, *and the order of working therby with examples. Chap. 10.*

Of the double rule called in Latine Regula duplex, *and the order of working thereby with examples, and in working thereby how to know when you haue to vſe* Regula euerſa, *or the common rule of three. Chap. 11.*

Of the rule of Felloſhip, and the order of working thereby, with diuers examples thereof. Chap. 12.

Of Progreſsion, what it is, and of the two kindes thereof, that is, Arithmeticall and Geometricall. Chap. 13.

Of Addition belonging to progreſsion Arithmeticall and the order thereof, with examples. Chap. 14.

Of Addition belonging to progreſsion Geometricall, & the order thereof, with examples. Chap. 15.

Of Proportion, what it is, and of the three kindes thereof, that is, Arithmeticall, Geometricall and Muſicall. Chap. 16.

Of Arithmeticall proportion, what it is, and how it is deuided. Chap. 17.

Of Proportion Geometricall, what it is, and how it is diuided. Chap. 18.

Of the chiefe and ſpeciall kindes of Geometricall Proportion, that is, of equalitie and inequalitie both greater and leſſer. Chap. 19.

Of Proportion of the greater inequalitie, and of the 2. kindes thereof, that is, Simplex, *and* Multiplex, *and of their diuers kinds, with certaine Tables belonging thereunto. Chap. 20.*

Of Proportion of the leſſer inequalitie. Chap. 21.

Of Muſicall proportion, what it is, and of the two kinds thereof, that is, Simple and compound, of which compound there be alſo two kinds that is proper and vnproper. Chap. 22.

How Proportions are to be ſet downe in writing, and how they are to be added, ſubtracted, multiplyed, and diuided euen like to fractions in all reſpects. Chap. 23.

How

How to finde out the ſquare roote of any number with examples. Chap. 24.

The vſe of the ſquare roote in ſetting of Battels, which according to the Italian vſe are to be ſet foure manner of wayes, the order whereof is here ſet downe with examples. Chap. 25.

How to find the Cubique roote of any number, and the order thereof with examples. Chap. 26.

Of Aſtronomicall Fractions, whereto they ſerue, and how to adde, ſubtract, multiplie, and to diuide the ſame. Chap. 27.

How to diuide ſuch fractions when the diuiſor is greater than the diuidend. Chap. 28.

Howe to take the ſquare roote of Aſtronomicall Fractions. Chap. 29.

And immediately after theſe Chapters doe follow the vſe of the Tables of Sines, lines Tangent, and lines Secant before mentioned, together with the Tables themſelues.

To

Of Arithmetike.

Cap. 1.

WHat is Arithmetike?

It is the art of counting or numbring by figures.

What is to number by figures?

It is to expresse the value of any number in his proper Characters and figures, which is called by a Latine name Numeration.

What belongeth to Numeration?

Two things, to know the shapes of the figures, and the signification of their places.

How many figures are there?

These ten. 1. 2. 3. 4. 5. 6. 7. 8. 9. 0. Whereof the tenth made like an. 0. as you sée here, is called a Cypher, which is no num of it selfe, but serueth onely to fill vp a number.

What is number?

Number is a collection or summe of many ones added together.

How is number deuided?

Into thrée kinds, that is Digit, Article and Compound.

Which be they?

The Digit is any of the first 9. figures before set downe. Article is any number ending in ten, as ten is one Article, twentie is two Articles, thirtie is thrée Articles, &c. Compound is that which is compounded of Article and Digit, as 13. 14. 17. 24. &c.

Shew what signification euery e Digit hath according to his

place, and in what order such place is to bee considered in expressing any number?

The order as touching the place, is to begin at the right hand, and so to procéde towardes the left hand. For any of the 9. Digits whatsoeuer, standing in the first place, which is on the right hand, signifieth the value of himselfe onely, in the second place ten times himselfe, in the third place a Hundreth times himselfe, in the fourth place a Thousand times himselfe, in the fift place ten Thousand times himselfe, in the sixt place a hundreth Thousand times himselfe, in the seuenth place a Myllion, in the eight place ten Myllions, in the ninth place a hundreth Myllions, in the tenth place a thousand Myllions, &c.

Doth the Cypher signifie nothing?

Yes it maketh a place whersoeuer it standeth, so as it be not the outermost on the left hand: for there it hath no place at all, as here you may sée in this number, 04500. whereof the first Cypher on the right hand, signifieth the first place, the second Cypher the second place, but the last and outermost Cypher on the left hand, signifieth no place at all, because it hath no Digit standing before it towards the left hand, and therefore though in this number there bee 5. figures, yet it signifieth no more but foure Thousand and fiue Hundreth.

By what meanes may a great number written in many figures, be readily expressed or tolde?

By diuiding the same into diuerse partes with strékes, or prickes made at the ende of euery third figure, beginning to tell from the right hand towards the left, as in this number, 4/320/570. In which, beginning with the Cypher on the right hand I tell one, two, and thrée, and there make a Stréke, and so procéding forth still towards the left hand, I make a Stréke at the ende of euery thirde figure, by which Strékes or partitions I make them now seuerall numbers, and euery Stréke must bee named by this word Thousand. Notwithstanding, in expressing this number being thus deuided, or any other such like, you must begin at the left hand, and say thus, foure Thousand thousand, thrée Hundreth twentie Thousand, fiue Hundreth and seuentie: for by reason of this Diuision, the figure 4. standeth here alone, and in the first place, and indeede signifieth 4. Myllions, and by

that meanes, you may more fitly expresse the said number in saying thus, foure Myllions, three Hundreth and twentie Thousand, fiue Hundreth and seuentie: And the better to discerne the Myllions from ỳ rest in great numbers, it shal not be a misse to set an M, signifiing Myllions, right ouer the head of ỳ Stręke which is drawn betwixt the sixth and seuenth figures, as in this example cõtaining a leauen figures, 34|545ᵐ|678|694. which is to be uttered thus, thirtie foure Thousand, fiue Hundreth foztie fiue Myllions, sixe Hundreth seuentie eight Thousand, sixe Hundreth nintie and foure Crownes, oz Pounds, oz whatsoeuer other denomination oz name, it shall please you to giue them.

Of the foure speciall kindes or parts of *Arithmetike*.

Cap. 2.

Which are those foure kindes?

These, Addition, Subtraction, Multiplication and Deuision.

Why is not Numeration also counted as a part?

Because Numeration together with the figures, and places whereof it consisteth, are counted rather as first Elements, and principles of Arithmetike, then as partes or speciall kindes thereof.

Of Addition.

What is Addition?

It is that which teacheth to bring manye seuerall summes into one summe.

How is that done?

First by placing euerye seuerall number one right vnder another, vnder which you must drawe a line, that done, you must adde together the numbers of the first rancke, beginning on the right

hand with the lowest figure of the same rancke, and so going vpward to the highest figure of the same rancke, and so from rancke to rancke, till you come to the last, and if the summe of any rancke doe not excéde the number of any of the foresaid 9. Digits, then set downe that Digit which comprehendeth that number right vnder his proper rancke, beneath the line, but if the Summe of that rancke, exceedeth the number of any one Digit by reason that it consisteth of Articles and Digits, then set downe the Digit and kéepe the Article or Articles in your minde, to be added to the first figure of the next rancke on the left hand, but if the summe be an euen Article or Articles: then set downe a Cypher, keeping the number of Article or Articles in your minde, bee it, one, two, or thrée, to be added to the next rancke, all which things you shall better vnderstand by this example here following. As for example, I spent in one yeare 125. l. in another yeare 234. l. and in another yeare 240. l. Now to knowe the totall Summe of all this, I place these seuerall summes one right vnder another, and then I draw a line vnder them as here you sée.

l.
125.
234.
240.
599.

Then beginning on the right hand with the lowest figure of the first rancke aboue the line, I say that a Cypher and 4. is but 4. Againe 4. and 5. maketh 9. which I set downe vnder the line, then procéeding to the seconde rancke twards the left hand, I say that 4. and 3. maketh 7. and 7. and 2. maketh 9. which I also set downe, then remouing to the third rancke, I say that 2. and 2. maketh 4. and 4. and 1. maketh 5 which I also set downe as you sée in the former example, so as the totall summe vnder the line is. 599. l.

Another example hauing Cyphers mixt with Digits. Here I say that 9. and 8. maketh 17. and 17. and 7. maketh 24. wherefore I set downe the Digit 4. and kéepe 2. Articles in minde, which being added to the lowest figure of the second rancke, which is 4. maketh 6. then 6. and 4. maketh 10. here I set downe a Cypher, képing one Article in mind, which being added to the figure 5. of the third rancke maketh 6. which I also set down, then I say that 3. and 4. maketh 7. and 7. and 3, maketh 10. for ỹ which I set down first a Cypher, and then because there is no more to be added, I set downe on the left hand the one Article which I had in minde, so as the whole

3047.
4508.
3049.
10604.

summe

Summe commeth to 10/604. as in the former example.

How are pounds, shillings, pence, halfe pence, and farthings and all other numbers of diuers Denominations to be added?

You must deuide euery seuerall name into diuers Collums or Spaces by themselues, and then beginning with the first on the right hand, you must adde euery Collum by it selfe, bringing farthings to halfe pence, and halfe pence to pence, pence to shillings, and shillings to poundes, setting the Summe of euery Collum vnder the nether line as you see in this example following.

℔	s̄	d̄	ob.	q̄
345	13	1	0	1
234	11	0	1	1
45	14	9	1	0
320	6	8	1	1
946	5	8	0	1

Heere first beginning with the Collum of farthings, I finde therein 3. farthings which is one halfe penie and one farthing. Wherefore I set downe the od farthing as you se, and kepe the halfe penie in minde: then adding the halfe pennie in minde to the lowest halfe pennie of the second Collum, I say that 1. in minde and 1. maketh 2 and 2. and 1. maketh 3. then 3. and 1. maketh 4. which 4. halfe pence because they make iust two pence, I set downe a Cypher keeping the two pence in minde, which two pence being added to 8. maketh 10. then 10. and 9. maketh 19. and 19. and 1. maketh 20. Now because that 20. d̄. maketh one shilling and 8. d̄. I set downe the 8. d̄. keeping the shilling in minde, which one shilling being added to the 6. of the next Collum maketh 7. then 7. and 4. maketh a 11. ℈ 11. and 1. maketh 12. then 12. ℈ 3. maketh 15. wherefore I set downe 5. keeping the Article in minde, which being added to one of the next Collum maketh 2. and 2. and 1. maketh 3. and 3. and one maketh 4. Articles, which 4. Articles maketh 40. s̄. which is two pound which I kepe in minde, and therefore I adde the 2. ℔. to the Collum of pounds, saying that 2. and 5. maketh 7. and 7, and 4. maketh a 11. and 11. and 5. maketh 16. wherefore I set downe 6. keeping the one Article in minde, which being added to 2. of the next Collum, maketh 3. then 3. and 4. maketh 7. and 7. and 3. maketh 10. then 10. and 4. maketh 14. wherefore I set downe 4. keeping one Article in minde, which being added to 3. of the next Collum maketh 4. then 4. and 2. maketh 6. and 6. and 3. maketh 9. which I also set downe, so as the

totall Summe amounteth to 946.l.5 s.8 d. no halfe penie, one farthing as you see in the former example.

How shall I know whether these seuerall Summes be truely added or not?

Some doe teach it to be done by culling out all the nines, which way is more tedious then sure: for the surest tryall indede is to be done by Subtracting the seuerall summes out of the totall Summe, of which Subtraction we come now to speake, for all the foure speciall kindes are tryed one by an other.

Of Subtraction.

Cap. 3.

WHat doth Subtraction teach?

It teacheth to take a lesser number out of a greater and to see what remayneth.

What is to be obserued in this kinde?

First, you must set downe your greater number aboue, and then the lesser number right vnder the same. As for example, I haue lent to one 564 l. and he hath paide me thereof 57. l. Heere to knowe what remaineth, I first set downe the number lent, and vnder that the number paide, and then drawe a line as you see in this manner.

Lent.	564. l.
Paide	57. l.

Here beginning on the right hand, I first say, take 7. out of 4. that cannot be, wherefore I take one Article of the next figure or place of the lent number, which Article being added to 4. maketh 14. then I saye take 7. out of 14. and there remaineth 7. which I set downe vnder the 4. then I adde that one Article which I borrowed, to the second figure of the paide number which is 5. saying that 5. and 1. in minde maketh 6. then take 6. out of 6. and there remaineth nothing, wherefore I set downe a Cypher, vnder the 5. of the paide number, then I procede to the third figure of the lent number, which

which is 5. and because I finde nothing written vnder it, nor haue nothing in minde to take out of it, I say, take nothing out of 5. and there remaineth still 5. so as the remainder is 507.l. as you see in this example following.

Lent	564.l.
Paide	57.l.
Remaine	507.

How shall I knowe whether this bee right or not?

By adding the remainder and the number paide together, the Summe whereof (if you haue done well) will be all one with the number lent, as in the former example, I first adde 7. and 7. together and that maketh 14. wherefore according to the precepts of Addition before taught, I set downe 4. keeping the Article in minde, then I say, one in mind and 5. maketh 6. which I also set downe, then I say nothing and 5. is 5. which I set downe in the third place, which in all maketh 564. a number equall to the number lent, as you see here following.

Lent	564.l.
Paide	57.
Remaine	507.
Proofe	564.

You may perceiue by this, that if any figure of the paid number be greater then the figure ouer him, out of the which it is to bee Subtracted, you must alwaies borrow one Article of his next fellow, to be added againe to him in his proper place. But you haue to note, that hauing to deale with numbers of diuers denominations, then in borrowing any number, you must alwaies haue respect to the Denomination or name of the thing, from whence you borrow, as in borrowing from shillings you borrow 12. and not 10. from pounds you borrow not one Article but 2. Articles which doe make 20.s. but when the whole number is altogether of one selfe Denomination, then you must alwaies borrow one Article which is 10. to make vp your number that wanteth. As you shall more plainely perceiue by this example containing numbers of diuers Denominations, as of pounds, shillings and pence, halfe pence, and farthings. Suppose therefore that you haue lent to one 467.l. 13.s. 4.d ob q. and hee hath paide you againe thereof, 89 l. 16.s 9.d. ob q. Here hauing set downe the summe lent in seuerall collums, according to their diuers names, and then the summe paide right vnder the same, drawe a line as you see in this example following.

	℔	s̄	d̄	ob	q
Lent.	467	13	4	1	1
Paide.	89	16	9	1	0
Remaine.	377	16	7	0	1

Here beginning with the first Collum on the right hand, I say take nothing out of one, and one stil remaineth, which I set down, then procéding to the next, I say take one out of one and nothing remaineth, wherefore I set downe a Cypher, then procéding to the next Collum, I say take 9. out of 4. that cannot be, wherefore I borrow a shilling of the next Collum that is 12. d̄. which being added to 4. maketh 16. pence, then I say take 9. out of 16. and there remaineth 7. which I set downe, then procéding to the next, I adde the one shilling which I borrowed, to the 16 which maketh 17 s̄. then I say take 17. s̄. out of 13. s̄. that cannot be, wherfore I borrow one pound which is 2. Articles of the next rancke, that is 20. s̄. which being added to the 13. s̄. maketh 33. s̄. then I say take 17. out of 33. s̄. and there remaineth 16. s̄. which I set down, then I adde the one pound which I borrowed, to 9 and that maketh 10. then I say take 10. out of 7. that cannot be; wherefore I borrow one Article out of the next 6. which being added to the 7. maketh 17. then I say take 10. out of 17. and there remaineth 7. which I set downe, then the one, which I borrowed, I adde to the 8. of the next rancke, and that maketh 9. Againe I say take 9. out of 6. that cannot be: wherefore I borrow one Article of the next 4. which being added to 6. maketh 16. then I say take 9. out of 16. and there remaineth 7. which I set downe, then I take the one which I borrowed out of the 4. & there remaineth 3. so as the remainder is as you sée in the former example. 377. ℔. 16. s̄. 7. d̄. no ob. 1. q.

How shall I trie whether this be true or not?

By adding the remainder and the Summe paide together: as in the former example, and of that Addition, will rise if you haue done truely a Summe like in euery condition to the Summe lent. In making which proofe or triall you cannot lightly erre, if you remember to reduce pence to shillings, and shillings to pounds, and therefore in the Collum of pence, no particular Summe can be aboue 11. d̄. nor in the Collum of shillings no particular Summe can be aboue 19. s̄. for if it be 20. s̄. then it is a pound and must be brought to the Collum of pounds.

Of

Of Multiplication.

Cap. 4.

WHat is Multiplication?

It is the producing or bringing forth of a third number, by Multiplying two other numbers the one into the other: And it consisteth of three numbers, that is the multiplycand, the multiplyer, and the product.

What signifieth those names?

The Multiplicand is that number which is to be multiplyed, and the multiplyer is that whereby the same is multiplied, & the product is the summe of such Multiplication: As for example, if I would multiply 4 by 3. as in saying 3. times 4. maketh 12. here the number of 4. is the Multiplycand, and the number 3. is the multiplyer, and the number 12. is the product of that Multiplycation.

What order is to bee obserued in multiplying, and how are those numbers to be set?

Before I teach you the true order of multiplying, I thinke it good to set you downe a table of Multiplycation, which vnlesse you learne perfectly by heart, you shall neuer multiplye readily nor quickly.

The first Table of Multiplycation.

2	2	4	3	5	15	4	9	36	6	8	48		9	9	81
2	3	6	3	6	18	4	10	40	6	9	54		9	10	90
2	4	8	3	7	21	5	5	25	6	10	60		10	10	100
2	5	10	3	8	24	5	6	30	7	7	49				
2	6	12	3	9	27	5	7	35	7	8	56				
2	7	14	3	10	30	5	8	40	7	9	63				
2	8	16	4	4	16	5	9	45	7	10	70				
2	9	18	4	5	20	5	10	50	8	8	64				
2	10	20	4	6	24	6	6	36	8	9	72				
3	3	9	4	7	28	6	7	42	8	10	80				
3	4	12	4	8	32										

How

How is this Table to be read?

In this manner 2. times 2. maketh 4. and 2. times 3. maketh 6. and 2. times 4. maketh 8. and so forth: multiplying still one Digit by another, vntill you come to a 100. for this Table serueth onely for Digits, which may bee made to extend so farre as you will, and vntil you haue learned the foresaid Table without booke, you may helpe your selfe with this other Table of Digits made squire wise as you see here.

1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	1
4	6	8	10	12	14	16	18	2	
9	12	15	18	21	24	27	3		
16	20	24	28	32	36	4			
25	30	35	40	45	5				
36	42	48	54	6					
49	56	63	7						
64	72	8							
81	9								

In the front of which Table are set down the 9. Digits beginning on the left hande, and so proceeding to the right hand, from 1. to 9. Againe on the right side of the said Table are set downe the foresaide 9. Digits beginning aboue and so proceeding right downe from 1. to 9. the vse whereof is thus, first seek the Digit to be Multiplyed in the front, and seeke the other wherby you haue to multiply the same on the right hand, and the square Angle answering to these 2. Digits will shew the product of such Multiplycation. As for example hauing to multiply 7. by 6. I first seeke the greater Digit which is 7. in the front, and the lesser which is 6. on the right hand, the product whereof I finde in the square Angle answering both to 7. and to 6. to be 42. and the like is to bee obserued in any 2. Digits that are of like value as 7. times 7. the product whereof is 49. But the first Table being perfectly learned without booke, whensoeuer you haue to multiply one number by another, you must obserue these rules here following.

First that you set downe the first figure of your multiplyer right vnder the first figure of the number that is to be multiplyed, on the right hand, and then orderly to place the rest of the figures of your multiplyer, be they few or many, towards your left hand, directly vnder the rest of the figures of the number that is to bee multiplyed, for if the figures stand not in order one right ouer another

other, it will breede a confusion in your working. Secondly you must not forget to multiply all the figures of the number that is to be multiplyed, by the first figure of your multiplyer before you deale with the next multiplyer, beginning alwaies on your right hand, and so to proceed from one to another, wherby you shal make as many seuerall products as there be figures in your multiplyer. Thirdly you must remember to set downe the first figure of euery seuerall product, right vnder the figure of that multiplyer, whereby you doe multiply, and hauing ended your Multiplication, draw a line vnder the seuerall products: ỳ done, ad the seuerall products together according to the rules of Addition, and the summe therof shalbe the total or general product of that Multiplycatiõ: al which rules you shall the better vnderstand by working this example following. Suppose thẽ that you would know how many houres ther are in a yeare, knowing first ỳ a yeare consisteth of 365. daies, here because that euery natural day containeth 24. houres comprehending both day & night, you haue to multiply 365. by 24. and therefore you must first set down 365. because it is the greater number, And is the multiplycand, which must alwaies stand aboue, & right vnder ỳ, your multiplyer which is 24. is to be set downe in his due place, according to the Rules before taught thus as you sée here.

365 the multiplicãd
24 the multiplier.

Then say thus 4. times 5. maketh 20. & hauing set down a Cypher right vnder the 4. kéep the 2. Articles in mind, thẽ say 4. times 6. is 24. & 2. in mind is 26. here set down 6, & kéepe 2. in minde, then say 4. times 3. is 12. which with the 2: in minde maketh 14. here first set downe the 4. vnder the 3. and because you can proceéde no further, you must therefore set downe hard by the 4. on the left hand the one Article which you had in minde, then hauing cancelled the first figure of the multiplyer, by making a Dash through it with your pen, as you sée in the example following: Proceede with the other figure of the multiplyer, saying that 2. times 5. maketh 10. wherefore set downe a Cypher right vnder the said 2. keeping the one Article in minde, then say, 2. times 6. is 12. and one in minde maketh 13. wherfore set downe 3. and keepe one in minde, then say 2. times 3. is 6. which with one in minde maketh 7. the which you must set downe, and because you haue made an end of your Multiplycation, cancel

the

the 2. and draw another line vnder the 2. seuerall products, that done, ad together whatsoeuer is contained betwixt the two lines, and you shall finde the generall product to be 8760. houres.

The multiplycand.	365
The multiplyer.	24
Theseu erall products.	1460
	730
The genetall product or total sum.	8760

How shall I knowe whether the last Multiplycation be right or not?

By diuiding the generall product by the Multiplyer, for in so doing your quotient will bee like vnto the first Summe that was Multiplyed, which you cannot doe, vntill such time as you haue learned to diuide, and therefore hauing first shewed certaine compendious waies of Multiplycation, I will then proceede to Diuision.

Certaine compendious waies of Multiplication.

WHen is any such way to be vsed?

When the Multiplyer beginning on the right hand with one Cypher or with many, endeth on the left hand with the digit 1. as these numbers following. 10/100/1000/ &c.

Why what is then to be done?

If you haue to Multiply by 10. then you haue no more to doe, but to set downe on the right hand of the number that is to bee Multiplyed, one Cypher, if by a 100. then 2. Cyphers, if by a 1000. then 3. Cyphers, as for example: if you would Multiply 365. by 10. then by setting downe on the right hand one Cypher as hath beene said, the product will be 3650. if you set downe 2. Cyphers the product wil be 36500. if you set down 3. Cyphers, then the product will be 365000.

What if the number do end on the left hand with any other Digit, as 2. 3. or more, as 200. 300. 400?

Then you must Multiply the number of the Multiplycand first by that Digit, and then adde to the end of the product on the right hand all the Cyphers annexed to the saide Digit, as if you woulde Multiply 365. by 200. First say 2. times 5. maketh 10. and 2. 6. and one in mind is 13. and so to proceed in Multiplying euerie figure of the Multiplycand by 2. and you shall finde the product

duct to be 730. whereunto if you adde on the right hand 2. Cyphers the whole product will be 73000.

Of Diuision.

Cap. 5.



What is Diuision?

Diuision is that whereby any number is diuided into as many parts as you will.

How many numbers are incident to Diuision and how are they called?

These foure, that is to say, the number which is to bee diuided which is called the diuidend, the second number whereby you do diuide which is called the Diuisor, the third number is called the quotient, which sheweth how many times the Diuisor is comprehended in the diuidend, and the fourth number is called the remainder, if any be.

What order is to be obserued in Diuision?

This here following, first set downe your diuidend and directly vnder that, beginning on the left hand, set downe your Diuisor, that is to say the first figure of your Diuisor right vnder the first figure of your diuidend on the left hand, and so consequently one after another proceeding towardes the right hand, which is alwaies to be done, so often as your Diuisor doth not exceed in quantitie, the figure standing right ouer his head, for if it doe, then you must remoue your Diuisor one figure further towardes the right hand. As for example, if you would diuide 487. by 53. you must not set the first figure of your Diuisor which is 5. vnder the first figure of your diuidend, which is but 4. but vnder the second figure of your diuidend which is 8. for you cannot take 53. out of 48. and therefore you must set the first figure of your Diuisor, vnder the second figure of the diuidend, and so follow on with the rest and then draw a line as you see here in this example following.

what is thē to be done? The diuidend. 487. (9. the quotient.
The diuisor. 53.

Then you must aske how many times 5. is comprehended in 48. and you shall finde that 5. is comprehended in 48. 9. times

which

which 9. being the quotient, must be placed on your right hande, behinde a crooked line made like a halfe Moone as you sée in the example aboue, then Multiply the first figure of the Diuisor by the quotient 9. and the product thereof shall be 45. which being taken out of 48. there will remaine 3. which you must set downe ouer the head of 8. and stréke out the 48. and also the first figure of your Diuisor which is 5. that done Multiply the second figure of your diuisor which is 3. by the foresaid quotient which is 9. & the product therof wil be 27. which being taken out of 37. ther remaineth 10. which you must set ouer the head of 37. and cancell the 37. and also the 3. beneath, as you sée in this example following.

Wherein you sée that the diuidend is 487. the diuisor 53 the quotient 9. and the remainder 10. which if you will apply to any vse, you may imagine that there is 487. l. to be diuided amongst 53. soldiours, and by working as before, you shal find that euery Souldiour must haue 9. l. and there shal be remaining 10. l. to be diuided amongst the foresaid 53. Souldiours, which 10. l. being reduced to shillings, may bee diuided amongst the Souldiours as well as the pounds: As for example if you Multiply 10. l. by 20. s. it will make 200. s. which being diuided by 53. the first Diuisor, the quotient will be 3. s. and the remainder 41. s and that being reduced into pence, which is doone by Multiplying 41. by 12. the quotient will be 9. d. and the remainder 15. d. which if you Multiply by 4. you shall reduce them to farthings, the product whereof will be 60. which product being diuided by 53. the first Diuisor you shall find in the quotient 1. farthing and the remainder to be $\frac{7}{53}$ of a farthing, the value of which Fraction how to find out is taught hereafter when wee come to speake of Fractions. So as you sée by this meanes that euery Souldiour shall haue for his share 9. l. 3. s. 9. d. q$\frac{7}{53}$. and some what more a thing of no moment.

	1	the remainder.
	30	
487.	487	(9 the quotient.
The diuisor.	53	

How many things are to be remembred in Diuision.

These fiue Rules here following. First that you put no number at one time in the quotient aboue 9. Secondly to moderate your quotient in such sorte, as hauing Multiplyed the first figure of the Deuisor by the quotient, there may remaine sufficient for the

the next figure of the Diuisor being Multiplyed by the quotient to be deducted out of that number which standeth right ouer his head. Thirdly that you Multiply euerye figure contained in the Diuisor by the quotient. Fourthly that if at any time in working it happeneth so as your Diuisor is not comprehended in the number ouer his head, then to put a Cypher in the quotient, and to remoue your Diuisor one figure further towardes the right hand, and that done to worke as before. Fiftly to sée that the last remainder, if there be any left, doe not exceede in quantitie the Diuisor, all which things you shall better vnderstand by this one example following: Suppose then that you haue to diuide 819096. by 92. here hauing set downe your diuidend and Diuisor in such order as is before taught, and as you see here in this example.

First aske howe many times 9. is in 81. and you shal find the quotient to be 8. which being Multiplyed into 9. maketh 72. which if you take out of 81. there shall remaine 9. which must be set downe ouer the head of the figure 1. and cancell the said 81. together with the first figure of the Diuisor, which is 9. then saye 2. times 8. is 16. which being Subtracted out of 99. there remaineth 83. which you must set ouer the head of the 99. and cancell the 99. that is aboue, and also the 2. beneath, as you sée in the former example. That done remoue your Diuisor towardes the right hand, that is to say, by setting the last figure of your Diuisor which is 2. vnder the next Cypher on the right hand, and place the first figure of your Diuisor which is 9. next to that towardes the left hand: then aske how many times 9. is comprehended in 83. and you shall find 9. times, which 9. must be set downe in the quotient next to the 8. then say 9. times 9. is 81. which being taken out of 83. there remaineth 2. then hauing set downe the 2. ouer the head of 3. cancel the 83. aboue & also the 9. beneath, then Multiply the last figure of the Diuisor which is 2. by the 9. which is in the quotient, and the product thereof is 18. which being taken out of 20. there remaineth 2. which must be set downe ouer the Cypher, and the Cypher cancelled, and also the 2. beneath, as

The diuidend. 8 1 9 0 9 6 (8 the quotiēt
The diuisor. 9 2

you

you sée in this example following.

That doone remooue your Diuisor one figure further towards the right hand by setting the 2. vnder the 9. which is the last figure saue one of the diuidend, and place the first figure of your Diuisor which is 9. next to that on the left hand, then aske how many times 9 is contained in 2. and you shall finde none, wherefore you must set downe a Cypher in the quotient and cancell the Diuisor as you see in this example.

	2	
The diuidend.	8 X 9 0 9 6	(890.
The diuisor.	9 2	

That done remoue your Diuisor againe by setting the 2. vnder the last figure of the diuidēd and place the 9. next to that on the left hand, then aske how many times 9. is contained in 29. and you shall finde 3. times, which 3. you must set downe in the quotient as you sée in the example following, then Multiply the first figure of your Diuisor which is 9. by 3. and the product thereof will be 27. which being taken out of 29. there will remaine 2. which 2. you must set ouer the head of 9 and cancell the 9. aboue, together with the 9. beneath, then Multiply the 3. which is in the quotient by the last figure of your Diuisor which is 2. and the product thereof will be 6. which being taken out of 26. there remaineth 20. wherefore you must set downe a Cypher ouer the 6. which is the last figure of the diuidend, and cancell the saide 6. aboue, and also the 2. beneath, and then you haue done rightly, and in such order as all the former examples and this also next following doe plainely shew.

		the remainder.	
		2 2 0	20.
The diuidend.	8 X 9 0 9 6	(8903	92.
The diuisor.	9 2		the quotient.

For heere you sée that ỹ diuidende is 819|096. the Diuisor 92. the Quotiente 8903. and the remainder 20. which remainder must be set on the right hand of the quotient ouer the Diuisor, hauing a line drawne betwixt them as you sée in the last example.

How

How shall I know whether I haue diuided truely or not?

By Multiplying the quotient by your Diuisor & by adding to the product thereof the remainder, for so shall you haue a number like to the first diuidend if you haue wrought well, if not, then your Summe will be either more or lesse then the diuidend.

Certaine compendious waies of Diuision.

IS there no shorter way of Diuision?

No, vnlesse the Diuisor hath one Cypher or more on the right hand, for then you may vse a breefer way by cutting off the last figure, or figures of the diuidend: As for example if you had to diuide 3708. by 10. here cut off the last figure 8. with a dash of your penne in this wise 370/8. and the quotient will bee 370. and the remainder shall be 8. Againe if you had to diuide the foresaid number by 100. then cut off the 2. last figures of the diuidend, that is the 8. and the Cypher standing next it, and then the quotient wil be but 37. and the remainder 8. as before, but if you haue to diuide any number by 1000. then you must cut off 3. figures of the diuidend, and so forth, remembring alwaies for euery Cypher in the Diuisor, to cut off one figure or Cypher of the diuidend.

Of halfing any number.

HOw is that done?

By diuiding the number by 2. As for example, if you would knowe the halfe of 3708. diuide the same by 2. and you shall find the quotient to be 1854. which is the iust one halfe of the diuidend.

Of the Rule of three otherwise called *the golden Rule whereof there be* three kinds, that is, the common Rule, the rule Reuerse, and the Double rule.

Cap. 6.

WHerefore is it called the Rule of three?

Becauſe that by 3. knowne numbers, it teacheth you to finde out a fourth number vnknowne.

How are ſuch 3. numbers to be placed?

The firſt is to be placed on the left hand, the third on the right hand, and the ſecond in the middeſt betwixt both.

How ſhall I know in what place each one is to be ſet?

By marking to what number the queſtion is annexed, for that muſt alwaies be the third number, and hauing the third number, you ſhall quickly haue the firſt, becauſe the firſt and third muſt alwaies be of one ſelfe Denomination or name, betwixt which two, the ſecond number is to be placed: As for example, let this bee the queſtion. If I pay 35. s̄. for 13. yards of Linnen cloth, how much ſhall I pay for 3. yards, here becauſe the queſtion is annexed to the number 3. yards, that muſt bee the third number and is to bee placed on the right hand, then becauſe that the number 13. yards is of the ſelfe ſame Denomination, that muſt be the firſt number, and is to be placed on the left hand, and the number 35. s̄. (which is the price) is to be placed in the middeſt betwixt the other two, as you ſée here following.

Now muſt you make your queſtion in this maner, if 13. yards did coſt me 35. s̄. what ſhall 3. yards coſt me, and ſo the firſt and laſt ſhal be of one denomination or name, that is to ſay yards.

yardes.	s̄.	yardes.
13.	35.	3.

What order is to be obſerued in working by this rule?

You muſt Multiply the third and ſecond numbers the one into the other, and diuide the product thereof by the firſt, and the quotient will ſhew you what the fourth number ſhould be, which fourth number is alwaies of like Denomination to the ſecond or middle number, as in the former example, firſt Multiply 35. by 3. and the product will be 105. which if you diuide by 13. the quotient will be 8. s̄. and one third of a ſhilling which is 4. d̄. and that is ỳ price of 3. yards which is the number that you ſéeke to know. And this is the common kind of working by the Rule of three whereof it is called the common Rule of three.

What if there be diuers Denominations either of Coyne as of pounds, ſhillings, and pence, or parts of yards, as quarters, and halfe quarters, and ſuch like?

Then

Then you must reduce them all to the smallest Denomination which belongeth to Fractions, whereof we come now to treate of.

Of Fractions.

Cap. 7.

WHat are Fractions?

They are broken partes of some whole thing called in Latine Integrum.

VVhat is Integrum?

Any thing that is whole, and not broken, or diuided into partes: As one whole yard, a pound, a shilling.

Of how many numbers doth a Fraction consist?

Of two, that is the Numerator, and the denominator, whereof the Numerator is alwaies set aboue, and the denominator beneath, hauing a little line drawne betwixt them thus $\frac{1}{2}$ which signifieth one second or one halfe, againe 2 thirds and three fourths are written thus, $\frac{2}{3}$ $\frac{3}{4}$ whereof the first signifieth two thirds, and the other three fourths and such like.

VVhat is ment by these two words Numerator, and Denominator, and whereto serue they?

The denominator is as much to say as the namer of the parts, which sheweth into how many parts the integrum is to be diuided, and the Numerator is as much to say as the numberer, and sheweth how many of those parts are to be taken: As for example $\frac{2}{3}$ of a shilling, here the nethermost called the denominator, sheweth that the shilling is to bee diuided into three parts, as into three groats, and the vpper number called the Numerator, sheweth that you must take 2. out of those 3. parts, so as $\frac{2}{3}$ of a shilling is as much to say as 2. groats or 8.d. Againe Fractions may be diuided into two kinds, that is, into simple Fractions, and into Fractions of Fractions.

Define those two kinds?

Simple Fractions are such as I spake of before which are the first & limediate parts of any integrum that is diuided into parts,

but if those Fractions bee diuided into moze Fractions, then are they called Fractions of Fractions, as when I say thze fourthes of two thirds, of six leuenthes and such like.

How are such Fractions to be set downe in writing?

In manner of simple Fractions thus $\frac{1}{4}$ of $\frac{2}{3}$ of $\frac{6}{7}$.

Make some demonstration of this example that I may the better vnderstand it?

Imagine that there is a whole peece of Golde of vii.s̄ as our Angel in times past hath bene, which vii.s̄. be the vii. parts of that peece of Golde, foz tryall whereof lay downe befoze you vii. twelue pennie peeces of Siluer, oz in steede thereof vii. counters, to signifie those vii. partes, of which vii. parts you must first take away vi. reiecting oz laying aside the od seuenth parte, then diuide those 6. parts into 3. parts, and euery such part will be iust 2.s̄. of which 3. parts you must take away 2. parts that is 4.s̄. reiecting the other third part which remaineth, that done, diuide those 2. parts which you haue taken away into 4. parts, which is 4.s̄. and take 3. of them reiecting the fourth part, so shall you find that $\frac{1}{4}$ of $\frac{2}{3}$ of $\frac{6}{7}$ of ꝑ foze-said peece of Golde is iust 3.s̄. and there remaineth still of the parts reiected 4.s̄. which being added to 3.s̄. that was taken away, doe make vp againe the whole Integrum of 7.s̄. Notwithstanding Fractions of Fractions doe seldome chaunce in the Diuision of any number, but if they do, you must reduce them into simple Fractions, befoze you can deale with them any manner of way, and because there are diuers rules belonging to Fractions, without the knowledge whereof you can nether adde, noz subtract them, noz yet ioyne them with any Integrum. I wil briefly set downe here seuen necessarie rules foz the same.

Seuen necessarie Rules belonging to Fractions.

1 WHat doth the first rule teach?

To bring Fractions of Fractions into simple Fractiõs.

How is that done?

Thus, Multiply the first Numerator into the second, and if there be any moze Fractions, then Multiply also the said product of the first two Numerators into the third Numerator, and that shall

shall be the Numerator of the simple Fraction, then Multiply the denominators in like manner, and the Summe thereof shall be the denominator of the simple Fraction, as in the former example ¼ of ⅓ of ⅚ here I Multiply the first 2. Numerators together, in saying 2. times 3. maketh 6. now because I haue a third Numerator, I multiply the product of the first 2. Numerators, which is 6. into the third Numerator which is also 6. saying, 6. times 6. maketh 36. and that shall bee the Numerator of the simple Fraction, which I set downe. Then by Multiplying the 3. denominators in like manner, I finde the denominator of the simple Fraction to be 84. the which I set downe vnder the 36. and draw a line betwixt them so as now I finde that ¼ of ⅓ of ⅚ do make $\frac{36}{84}$ which indeed is no more but ⅜ as you shall learne hereafter by the first rule.

What doth the second rule teach? 2

To bring Fractions being more in value then Integrums into Integrums.

When are Fractions said to be more then Integrums?

When the Numerator is a greater number then the denominator, for if they be both of like value as $\frac{14}{14}$ and such like, then such Fraction is an euen Integrum.

How shal I know how many Integrums such Fractions as be more then Integrums doe containe?

By diuiding the Numerator by the denominator, and if any thing remaine, write that aboue the denominator, as in this example $\frac{806}{7}$ here if you diuide 806. by 7. which is the denominator, you shall finde the quotient to containe 115. Integrums, and the remainder to be 1. which is ⅐.

What doth the third rule teach? 3

To bring Integrums into parts by Multiplying the number of the Integrums by the denominator of those partes, as if you would bring 64. yards into quarters, Multiply 64. by 4. and there will arise thereof 256. quarters.

What doth the fourth rule teach? 4

It teacheth to bring Integrums hauing Fractions annexed to them, into one Fraction.

How is that done?

Multiply the number of the Integrums by the denominator of the Fraction annexed, and then adde to the product y Numerator

of the said Fraction, and that summe shall be the Numerator, vnder which write the denominator aforesaid, and so you shall finde that 23. Integrums hauing $\frac{2}{3}$ annexed thereunto shall make $23\frac{2}{3}$.

What doth the fift rule teach?

5. It teacheth to expresse a Fraction written with many figures, in so fewe as may be.

How shall I doe that?

Thus, find out some number that may first diuide the Numerator, and then the denominator seuerally by themselues, without leauing in either of them any remainder, and the quotient of the first Diuision will shew the Numerator, and the quotient of the second Diuision will shew the denominator, but if you cannot readily finde out a number that will diuide them both without leauing some remainder, then leaue not to Subtract the lesser number out of the greater, vntill you finde two like numbers, by one of the which two like numbers diuide both the Numerator, and also the denominator seuerally as before, and the quotient will shew that which you seeke: but if such 2. like numbers cannot be found, then you may assure your selfe that the Fraction cannot be written in fewer figures then they already be.

Giue examples of these two waies?

For example of the first way, suppose that you would expresse $\frac{9}{12}$ in lesser numbers, here seeke out some number that may diuide euenly both the Numerator, and also the denominator, without leauing in either of them any remainder, which by diuiding each of them by the number of 3. you may doe: For by asking how many times 3. is contained in 9. the quotient will be 3. and in asking how many times 3. is contained in 12. the quotient shall be 4. so shall you find $\frac{9}{12}$ to be no more then $\frac{3}{4}$. Now for example of the second way, let $\frac{27}{81}$ be the Fraction which you would set down in fewer figures, here because you cannot readily find out a number that wil euenly diuide both the Numerator and the denominator, Subtract the lesser out of the greater, that is to say 27. out of 81. and there will still remaine 54. from which Subtract 27. and there will remaine 27. which 2. numbers because they are both like, diuide the Numerator and denominator of the foresaide Fraction, each of them by one of these numbers, that is to say by 27. and the quotient of the first Diuision wil shew you the Numerator which

is

is 1. and the quotient of the second Diuision will shew you the denominator which is 3. so as you shal find $\frac{1}{3}$ to be as much in value as $\frac{27}{81}$ and note that when there be Cyphers both in the Numerator and in the denominator standing in such sorte as they may bee euenly cut off, the remainder wil shew the fewest figures, wherein the Fraction may bee written as $\frac{200}{500}$ here by cutting off the two Cyphers as well beneath as aboue the line, with a dash of your penne in this manner $\frac{2}{5}\frac{00}{00}$ the remainder shall bee $\frac{2}{5}$ which is as much in value as $\frac{200}{500}$. And Fractions may be set downe in Minimis, that is to say in the least numbers more readily by Diuision thē by Subtraction in this manner: first diuide the greater number by the lesser, and if there be no remainer left: then by that remainer diuide the last Diuisor that went next before, continuing still so to doe, vntill you find such a number as will euenly diuide the last Diuisor, without leauing any remainer, for that number will diuide both the Numerator and also the Denominator of the giuen Fraction, without leauing any remainer. As for example, suppose the giuen Fraction, to be $\frac{36}{15}$ which you would set downe in Minimis or smallest numbers: here hauing diuided 36. by 15. you find the remainer to be 6. by which 6 you haue to diuide againe the last Diuisor which is 15. and you shall finde the remainer to bee 3. which doth euenly diuide 6. without leauing any remainer at all. Wherefore you may boldly say that 3. is the common Diuisor, as wel to the Numerator as to the Denominator of the giuen Fraction, for if you diuide 36. by 3. you shall finde in the quotient 12. which shall be the Numerator of the new found Fraction, & by diuiding the Denominator of the giuen Fraction, which is 15. by 3 you shall haue in the quotient 5. and that shall be the Denominator of the new found Fraction, so shall the new found Fraction be $\frac{12}{5}$ which is in value as much as the giuen Fraction $\frac{36}{15}$. And you haue to note that such numbers as may be euenly diuided by another number without leauing any remainer, are called compounds. But such as cannot be diuided but that there will remaine some od Unite, those are called Primes. You haue also to vnderstand that if the giuen Fraction bee such as the greater number thereof, may at the first bee euenly diuided by the lesser number, without leauing any remainer, then the quotient of that first Diuision shall be the common Diuisor. As for example let $\frac{27}{81}$ be the

giuen Fraction, as it was in the first example that was to bee wrought by Subtraction, here by diuiding the greater number by the lesser, you shall finde no remainer, but onely 3. in the quotient which is the common Diuisor, for if you diuide the Numerator of the giuen Fraction 27. by 3. the Numerator of the new founde Fraction will be 9. and hauing diuided the Denominator of the giuen Fraction which is 81. by 3. the Denominator of the newe found Fraction will be 27. which is no more in value but $\frac{1}{3}$ for if you diuide 9. by 3. the quotient will be 3. and if you diuide 27. by 3. the quotient will be 9. againe by diuiding 9. by 3. the quotient will be 3. then aske how many times 3. is contained in 3. and there will be but 1. and by asking how many times 3. is contained in 9. you shall finde 3. so as the new Fraction shall be $\frac{1}{3}$ and thus you see that $\frac{9}{27}$ or $\frac{3}{9}$ is either of them but $\frac{1}{3}$ and that the number 3. which was the first quotient, is the common Diuisor as well to the Numerator as to the Denominator of the first giuen Fraction. And looke as compound Fractions may bee set downe in Minimis by Diuision, so may cõpound proportions be set downe in Minimis by like manner of Diuision, as shall be declared hereafter when we come to speake of proportions.

6. What doth the sixt rule teach?

To finde out the value of the fraction of any Integrum.

It teacheth to find out the value of the Fraction of any integrum.

How is that done?

Thus, Multiply the Numerator by the knowne partes of the Integrum, and diuide the product thereof by the denominator, so shall you haue the value of the Fraction: As for example, if you would know the value of $\frac{3}{4}$ of an Angel, consider first what parts an Angel hath, and you shall find the parts thereof to bee 10. s̄. or 30. groats, here if you Multiply 3. by 10. s̄. it will make 30. s̄. which being diuided by 4. you shall finde in the quotient 7. s̄. and the remainder to be $\frac{2}{4}$ or one half of a shilling, which is 6. d̄. Againe if you Multiply 3. by 30. groates it will make 90. groats, which being diuided by 4. you shall finde in the quotient 22. groats, and the remainder to be $\frac{2}{4}$ or one half of a groat which is 2. pence, making in all 7. s̄. 6. d̄. like vnto the first Summe, so as you see that $\frac{3}{4}$ of an Angel is 7. s̄. 6. d̄. and thus you may deale with the Fractions of any other Integrum that hath knowne parts.

7. What doth the seuenth rule teach?

It

It teacheth to bring Fractions of diuers denominations to one selfe denomination, without the which nether Addition, nor Subtraction of Fractions can bee made: As for example if you would adde $\frac{2}{3}$ and $\frac{4}{5}$ together, you must first bring them to one selfe denomination thus, Multiply the denominators the one into the other, and the product thereof shall be a common denominator to both the Fractions, wherefore say 3. times 5. do make 15. which must be set downe in 2. seuerall places by themselues thus, 15. and 15. then multiply the Numerator of the first Fraction into the denominator of the second, as 2. into 5. maketh 10. which set downe ouer the first common denominator thus $\frac{10}{15}$ then Multiply the Numerator of the second Fraction into the denominator of the first Fraction, as 4. into 3. which maketh 12. and that must bee likewise set downe ouer the second common denominator thus $\frac{12}{15}$ so shall you find that $\frac{2}{3}$ and $\frac{4}{5}$ are all one in value with $\frac{10}{15}$ and $\frac{12}{15}$.

Addition of Fractions.

Cap. 8.

HOw are Fractions to be added together? Fractions being first brought to one denomination are eallly added, for then you haue no more to doe but to adde the Numerators together, and to write the common denominator vnder the Summe of such Addition, as in the former example, $\frac{10}{15}$ being added to $\frac{12}{15}$ maketh $\frac{22}{15}$ but if the denominators be not like, then you must make them like by the seuenth rule before taught.

What if there bee three Fractions of diuers denominations to be added together as $\frac{2}{3}$ $\frac{1}{4}$ $\frac{4}{5}$.

Then hauing reduced the 2. first to one self denomination adde the 2. Numerators together and write vnder the Summe thereof the common denominator, that done, deale with that Fraction last found, and with the third as you did before with the 2. Fractions that had diuers denominations, and so you shall find that $\frac{2}{3}$ and $\frac{3}{4}$ being

giuen Fraction, as it was in the first example that was to bee wrought by Subtraction, here by diuiding the greater number by the lesser, you shall finde no remainer, but onely 3. in the quotient which is the common Diuisor, for if you diuide the Numerator of the giuen Fraction 27. by 3. the Numerator of the new founde Fraction will be 9. and hauing diuided the Denominator of the giuen Fraction which is 81. by 3. the Denominator of the newe found Fraction will be 27. which is no more in value but $\frac{1}{3}$ for if you diuide 9. by 3. the quotient will be 3. and if you diuide 27. by 3. the quotient will be 9. againe by diuiding 9. by 3. the quotient will be 3. then aske how many times 3. is contained in 3. and there will be but 1. and by asking how many times 3. is contained in 9. you shall finde 3. so as the new Fraction shall be $\frac{1}{3}$ and thus you see that $\frac{9}{27}$ or $\frac{3}{9}$ is either of them but $\frac{1}{3}$ and that the number 3. which was the first quotient, is the common Diuisor as well to the Numerator as to the Denominator of the first giuen Fraction. And looke as compound Fractions may bee set downe in Minimis by Diuision, so may cõpound proportions be set downe in Minimis by like manner of Diuision, as shall be declared hereafter when we come to speake of proportions.

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What doth the seuenth rule teach?

It

It teacheth to bring Fractions of diuers denominations to one selfe denomination, without the which nether Addition, nor Subtraction of Fractions can bee made: As for example if you would adde $\frac{3}{5}$ and $\frac{4}{5}$ together, you must first bring them to one selfe denomination thus, Multiply the denominators the one into the other, and the product thereof shall be a common denominator to both the Fractions, wherefore say 3. times 5. do make 15. which must be set downe in 2. seuerall places by themselues thus, 15. and 15. then multiply the Numerator of the first Fraction into the denominator of the second, as 2. into 5. maketh 10. which set downe ouer the first common denominator thus $\frac{10}{15}$ then Multiply the Numerator of the second Fraction into the denominator of the first Fraction, as 4. into 3. which maketh 12. and that must bee likewise set downe ouer the second common denominator thus $\frac{12}{15}$ so shall you find that $\frac{3}{5}$ and $\frac{4}{5}$ are all one in value with $\frac{10}{15}$ and $\frac{12}{15}$.

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What if there bee three Fractions of diuers denominations to be added together as $\frac{2}{3}$ $\frac{3}{4}$ $\frac{4}{5}$.

Then hauing reduced the 2. first to one self denomination adde the 2. Numerators together and write vnder the Summe thereof the common denominator, that done, deale with that Fraction last found, and with the third as you did before with the 2. Fractions that had diuers denominations, and so you shall find that $\frac{2}{3}$ and $\frac{3}{4}$ being

being first brought to one denomination, and then added together doe make $\frac{17}{12}$ whereto if you will adde $\frac{4}{5}$ then you must bring them againe to one selfe denomination, and so you shall finde that $\frac{17}{12}$ and $\frac{4}{5}$ doe make $\frac{85}{60}$ and $\frac{48}{60}$ which last 2. Numerators being added together doe make in all $\frac{133}{60}$ which is 2. Integrums and $\frac{13}{60}$.

Subtraction of Fractions.

HOw are Fractions to be Subtracted, one out of another, or out of Integrums?

First make the denominators like as you did before in Addition, then take the lesser Numerator out of the greater, and vnder the remainder thereof write the common denominator, so shall you finde that $\frac{3}{7}$ being taken out of $\frac{6}{7}$ there remaineth $\frac{3}{7}$ but if you would Subtract Fractions out of Integrums, then you must take one of the Integrums and breake it into partes. As for example, to Subtract $\frac{3}{7}$ out of 9. Integrums take one from 9. and breake it into parts making it $\frac{7}{7}$ for that is one Integrum, for whensoeuer the Numerator is made like and equall to the Denominator, it signifieth one Integrum, then take $\frac{3}{7}$ out of $\frac{7}{7}$ and there remaineth $\frac{4}{7}$ and 8. Integrums.

What is to be obserued in breaking the Integrum?

In breaking the Integrum, you are to bee directed alwaies by the denominator of the Fraction which you haue to Subtract, for the Integrum which should be the Numerator, must be equall in value to the said denominator, as before is said.

Multiplycation of Fractions.

HOw are Fractions to be Multiplyed by Fractions, or Integrums by Fractions?

As touching Fractions, Multiply the Numerator one into another, and the product thereof shall bee the Numerator, then Multiplythe denominators in like manner, and the product thereof shall be the denominator, so shall you find that $\frac{1}{5}$ being Multiplyed by $\frac{1}{4}$ doe make $\frac{1}{20}$. But if you would Multiply integrums by Fractions, then Multiply the integrums by the Numerator of the

the Fraction, and vnder the product thereof, set downe the denominator of the same Fraction, drawing a line betwixt them, so shal you find that 20. integrums being Multiplyed by $\frac{5}{12}$ doe make $\frac{100}{12}$ that is to say 8. integrums and $\frac{4}{12}$ which is $\frac{1}{3}$, &c.

Diuision of Fractions.

HOw are Fractions to bee diuided by Fractions, or Integrums by Fractions, or Fractions by integrums?

The diuision of Fractions is done by Multiplycation thus, first set downe your diuidend on the left hand, and the Diuisor alwaies on the right hand, and then draw 2. crosse lines like a Saint Andrews crosse betwixt them which shall direct you in your working: As for example, if you woulde diuide $\frac{2}{3}$ by $\frac{4}{5}$ set them downe thus $\frac{\text{diuidend } 2}{3} \times \frac{\text{diuisor } 4}{5}$ and worke as followeth, first Multiply the Numerator of the diuidend, by the denominator of the Diuisor, and the product thereof shal be the Numerator, then Multiply the denominator of the diuidend, by the Numerator of the Diuisor, and that shall bee the denominator, so shall you finde that $\frac{2}{3}$ being diuided by $\frac{4}{5}$ there remaineth $\frac{10}{12}$ that is $\frac{1}{6}$ but if you would diuide Integrums by Fractions, or contrariwise Fractions by integrums, then make of the Integrums a Fraction, by setting down 1. in the place of a denominator vnder the Integrums, and worke as before, so shall you finde that $\frac{2}{1}$ Integrums being diuided by $\frac{1}{4}$ doe make $\frac{24}{3}$ contrarily if you diuide $\frac{3}{4}$ by $\frac{7}{1}$ Integrums, there will arise $\frac{3}{28}$.

What if I haue to diuide Fractions annexed to Integrums?

Then you must first reduce each Integrum with his Fraction annexed, into one selfe Fraction by the fourth rule of Fractions before taught. As for example, if you would diuide 9. Integrums hauing $\frac{3}{4}$ thereunto annexed, by 3. Integrums and $\frac{1}{3}$ here the fourth rule of Fractions teacheth you first to Multiply the Integrum 9. by 4. which is the Denominator of the Fraction annexed, the product whereof is 36. whereunto by adding the Numerator of the same Fraction which is 3. you shal make the Numera-

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tor of the diuidend to be 39. vnder which you must set the denominator 4. thus $\frac{39}{4}$ and that is your whole diuidend, then hauing in like manner brought the Diuisor which is 3. Integrums and $\frac{2}{5}$ into one selfe Fraction, worke as the former rule of Diuision teacheth you, and you shall produce $2\frac{17}{40}$ which is 2. Integrums and $\frac{17}{40}$.

The Rule of three belonging to *Fractions*.

Cap. 9.

WHat order is to bee obserued in this Rule hauing to deale with Fractions onely?

The selfe same order that hath beene taught before touching Integrums: for in working with Fractions you must haue also 3. seuerall numbers, and you must see that the first and third numbers bee of one selfe Denomination, and that number is to bee placed alwaies in the third place whereunto the question is annexed, and then to Multiply the second by the third, and to diuide by the first, and so the fourth number which you seeke to know, shall appeare: As for example if $\frac{3}{4}$ of an ell of fine Holland cost me $\frac{2}{3}$ of an English crowne, in value 15. groats, what shall $\frac{5}{6}$ of an ell cost me, here first you must set downe your 3. seuerall numbers in order thus, $\frac{3}{4}$ ell $\frac{2}{3}$ $\frac{5}{6}$ ell so as the first and third may bee one selfe denomination, then Multiply the second and third Fraction the one into the other, which will make $\frac{10}{18}$ and that being diuided by $\frac{3}{4}$ which is the first Fraction will produce $\frac{40}{54}$ of a crowne, the value of which Fraction if you seeke to know by helpe of the sixt rule of Fractions, teaching you to Multiply the Numerator of the Fraction, by the knowne parts of a crowne which are 5.s. or 15. groats, you shall finde the value of that Fraction to be 11. groats and $\frac{6}{18}$ of a groat, which is one farthing and somewhat more, supposing the least knowne parts of a groat to be 16. farthings.

The

The Golden Rule reuerse called in *Latine regula euersa that is to say turned back-ward.*

Cap. 10.

WHat is the order of this rule?

Multiply the first by the second, and diuide the product thereof by the third, as if a pennie Loafe must waigh 2.℔. Wheate being at 3.s̄.the bushel, what shall a pennie Loafe waigh when Wheate is at 2.s̄.the bushel, the question must be framed thus, if 3.s̄.require 2.℔.waight, what shall 2.s̄.haue, then by working according to this rule you shall finde that the pennie Loafe must waigh 3.℔.

Another example of the same rule.

I would know how many yardes of Bayes bearing in breadth $\frac{3}{4}$ will suffice to line 7. yardes of Silke bearing in breadth three quarters and a halfe. Here you must frame your question thus, if $\frac{3}{4}$ and $\frac{1}{2}$ require 7. yards, what shall $\frac{3}{4}$ require, but because the first and third number of this question are not of one selfe denomination by reason of the Fraction annexed to the first number, you shall doe well to reduce the first and third number both into halfe quarters, and then to worke as though they were all Integrums, which is more easie then to make all the numbers Fractions, wherefore say thus: If 7. halfe quarters doe require 7. yardes, what shall 14. halfe quarters require, and in working by the Rule Reuerse, you shall finde in the quotient 3. yards of Bayes and a halfe.

The double Rule called in Latine. *Regula duplex.*

Cap. 11.

WHereto ſerues this rule and what order is to be obſerued therein?

This rule ſerueth to vnfold two queſtions wrapt in one, as thus. If I pay 4.d. for the carriage of 20.l. waight 30. miles, what ſhall I pay for the carriage of 50 l. waight 60. miles, here of this and ſuch like demaunds, you muſt make two ſundrie queſtions, and the fourth Summe of the firſt queſtion being found, ſhall bee the ſecond or middle number of the ſecond queſtion: wherefore frame your firſt queſtion thus, if 20.l. coſt 4.d. what ſhall 50.l coſt, and you ſhall finde that it wil coſt you 10.d. then ſay if 30. miles coſt 10.d. what ſhall 60. miles coſt, and you ſhall finde that it will coſt 20.d. And note that each of theſe 2. queſtions is to be wrought by the common rule of three that is to ſay by Multiplying the ſecond into the third, and by diuiding the product thereof by the firſt, and the fourth found number of the firſt queſtion muſt be the ſecond, or middle number of the ſecond queſtion, as in the former example, you ſee that 10.d. which was the fourth found number, is here the middle number of the ſecond queſtion.

Another Example

If 25.l. doe gaine me 8.l. in 4. yeares, how much ſhall a 100.l. win one in 10. yeares, both theſe queſtions are alſo to bee wrought by the common rule of 3. Wherefore ſet downe the firſt queſtion thus, if 25.l. yeldeth 8.l. what ſhall 100.l yelde, and you ſhall finde 32.l. then ſay 4. yeares yeldeth 32.l what ſhall 10. yeares yelde, and you ſhall find 80.l. But note that theſe double

ble questions, may be put in such sort as you must worke the first or second question, sometimes by the rule reuerse. As in this question here following, if 6. ℔ win 8. Crownes in 10. yeares, in how many yeares shall 3 ℔. win 12. Crownes, here frame your first question thus, if 6. ℔. require 10. yeares how many yeares shall 3 ℔. require: And in working this question by the rule Reuerse, you shall finde 20. yeares, then for the second question say thus, if 8. Crownes require 20. yeares, how many yeares shal 12. Crownes require: Here if you worke by the common rule of three, you shall finde 30. yeares.

Another Example.

If 7. horses doe eate 12. bushels of Oates in 20. daies, how many bushels shall 14. horses eate in 15. daies, here frame your first question thus, if 7. horses do eate 12. bushels, what will 14. horses eate, and in working by the common rule of three you shall finde in the quotient 24. bushels, then frame your question thus, if 20. daies require 24. bushels, what shall 15. daies require, here in working by the common rule of three you shall finde in the quotient 18. bushels.

Another Example

If ten reapers reape 15. Acres in 7. daies, in how many daies shall 16. reapers reape 20. Acres: Here frame your first question thus, if 10. reapers require 7. daies, how many daies shall 16. reapers require, which question must be wrought by the rule Reuerse, and so you shall finde 4. daies and $\frac{3}{4}$ of a day which is 9. houres, then say, if 15. Acres require 4. daies and $\frac{3}{4}$ of a day, how many daies shall 20. Acres require, and in working this second question by the common rule of three belonging to Fractions as is before taught, you shall finde that 20. Acres will require 5. daies and $\frac{10}{12}$ or $\frac{5}{6}$ of a day which is 20. houres. But it were more easie in this second question to reduce the daies into houres by Multiplying the 4. daies by 24. houres, the product whereof will be 96. houres, whereunto if you adde the odd 9. houres it will make in all 105. houres, which being Multiplyed by the third number of this

second question, which is 20. the product shall be 2100. houres, which diuided by the first number of the said question which is 15 you shall finde in the quotient 140. houres, which if you diuide againe by 24. you shall finde in the quotient 5. daies, and the remainder to be 20. houres, which agreeth in all pointes with the first manner of working by Fractions, and is the easier way of the two.

How shall I know hauing to worke by this Double Rule, when to vse the Rule reuerse?

By considering whether the third number requireth more or lesse of time, or of any other measure or quantitie, as in the former example, of Bayes for lining, the more breadth it had, the lesse did serue for lining. Againe in the example of the gaine by yeares, of 6.£. and 3.£. you did see that 3.£. require more yeares then 6.£. and therefore that first question was wrought by the rule reuerse: Also in this last example of the reapers, the more reapers, the lesse time they require, and therfore that question was wrought by the rule reuerse.

The Rule of Fellowship.

Cap. 12

WHat doth this rule teach?

To knowe the gaine or losse of such as do make a stocke and doe occupie together in the trade of Marchandize: As for example, foure Marchants did put their mony in lot in this manner. The first brought 30. Crownes, the second 50. the third 60 and the fourth 100. and with these portions they gained 3000. Crownes, the question is how much euery one shall haue to his share of that gaine according to the portion which he brought. To know this, you must first gather all the seuerall portions together by Addition into one Summe, and you shall find the summe of the portions to be 240. Crownes, then say if 240. Crownes doe gaine 3000. Crownes, what shall 30. gaine,

and

and after this manner worke by the common rule of 3. with al the rest of the portions, and so you shall finde that hee which brought 30. ought to haue 375. Crownes, and he that brought 50. ought to haue 625. Crownes, and hee that brought 60. ought to haue 750. Crownes, and hee that brought 100. ought to haue 1250. which maketh in all 3000. Crownes, for that is the very summe of the gaine before set downe, the order of working whereof, this figure plainely sheweth.

240 —— 3000 —— { 30 —— 375. / 50 —— 625. / 60 —— 750. / 100 —— 1250.

The common Diuisor which is the Summe of the particular portions added together } the generall gaine } the particular portions } euery e mans single share.

A like example of losse receiued by Shipwracke.

Three Marchants doe venture their goods in one Shippe, the goods of the first were worth 300. Crownes, the second 400. the third 500. there were as much goods cast out as was worth 100. Crownes, the question is how much euery one should loose according to his portion, here worke as before, and you shall find that euery one shal lose so much as this figure following sheweth.

1200 —— 100 —— { 300 —— 25 / 400 —— 33. 1/3. which is 5. groats. / 500 —— 41. 2/3. which is 10. groats.

The cõmon diuisor which is the Sum of the particular portions added together } the generall losse } the particular portions } euery e mans seuerall losse

Here to know whether the 3. seuerall losses doe make by the generall losse, do thus, first adde the Integrums of the seuerall losses together, the Summe whereof will bee 99. whereunto if you adde the 2. Fractions which doe make one whole Crowne,

the Summe will be 100. a number like vnto the generall losse.

Another Example.

Three Marchants haue bought 1000.l. of Pepper for 300. crownes, the first taketh 200.l. the second 350.l. and the third 450.l. what shall euery man pay according to the portion which he hath receiued, then say if 1000.l. be worth 300. Crownes, what is 200.l. worth, here working by the common rule of 3. with euery mans seueral portion receiued, you shall find that the first must pay 60. Crownes, the second 105. and the third 135. Crownes, as this figure here following sheweth.

	l		
1000	300	200	60.
		350	105.
		450	135.

The common Diuisor. | the generall price. | the seueral portions receiued. | euery mans particular paiment.

Another like example of diuers distance of time.

Three Marchants occupying together did gaine 2345. Crownes, the first put in 40. Crownes for the space of 14. Moneths, the second put in 50. Crownes for the space of 8. Months, and the third put 85. Crownes for the space of 6. Moneths, the question is, how much euery one shall haue after the rate of his mony, and according to the quantitie of time: This is to bee wrought according to the rule of Fellowship thus, Multiply euery mans mony by his time, either of which, that is to say, the mony and the time must be of one selfe denomination, then adde the Summes of those seueral portions together, and the total summe of such Addition shall be the first number, and the common gaine shall be the second number, and the third number shall bee euery mans mony Multiplyed by his time, then in working by the common rule of 3. you shall finde that euery man shall haue such share as this figure here following sheweth.

1470.

1470 —— 2345 —— { 560 —— 893.$\frac{1}{3}$ / 400 —— 638.$\frac{2}{21}$ / 510 —— 813.$\frac{4}{7}$

The common Diuisor which is the totall Summe of the seuerall portions of money added together. | the generall Summe of the gaine. | the particular portions of the mony multiplyed by his time. | euery mans single share.

Now if you woulde know whether the single shares in this example doe make vp the generall Summe of the gaine, then adde together the Integrums or whole Summes of euery mans single share, and you shall finde the Summe to bee but 2344. which wanteth one whole Integrum of the second or middle number of the question, which you shal easily supply by adding the 3. seuerall Fractions together according to the rule of Addition of Fractions before taught, for so shall you finde the saide 3. Fractions to make in all one whole Integrum, which being added to 2344: will be aunswerable to the second number of the question, which as you see in the example is 2345. And remember in adding together the said 3. Fractions, to set them in this order $\frac{1}{3}/\frac{2}{21}/\frac{4}{7}$. and then to bring them to one selfe denomination, as the seuenth rule of Fractions teacheth you. But first because you shall find ỹ 3. remainders after the first 3. Diuisions of the 3. seuerall portions, made by the first common Diuisor of the question to be written in many figures, you must set them downe in fewer figures according as the fift rule of Fractions teacheth you, so shall you finde the first remainder containing $\frac{490}{1470}$ to bee no more but $\frac{1}{3}$ and the second remainder containing $\frac{140}{1470}$ to be $\frac{2}{21}$ and the third remainder containing $\frac{840}{1470}$ to be $\frac{4}{7}$ which 3. Fractions being added together according to the seuenth rule of Fractions, will make $\frac{441}{441}$. which is one whole Integrum and must be added by the name of 1 to the middle or second number of the question, as I haue said before: you may also make vp the foresaide number by seeking to knowe the value of euery Fraction annexed to the Integrums, according as the sixt rule of Fractions teacheth, for so shall you finde the value of the first Fraction to be fiue groats, and the value of the second Fractiõ to be one groat 6. farthings, and $\frac{12}{21}$ of a far-

thing, & you shall find the value of ỳ third Fraction to be 8. groats 9. farthings, and $\frac{1}{7}$ of a farthing, & if you adde $\frac{18}{21}$ & $\frac{1}{7}$ of a farthing together, you shall finde that it will make $\frac{147}{147}$ which is one whole Integrum or one whole farthing. Now if you adde 6. 9. and 1. farthings together, it will make in al 16. farthings, & that is 1. groat, which being added to ỳ 14. groats before found out, will make in al 15. groats which is one Crowne, and that being added to the sum 2344. will make it 2345. Crownes, which is a number agreeable to the middle Summe of the question. Truely if you exercise your selfe in this and such like questions, it will make you perfect not onely in Addition, Subtraction, Multiplycation, and Diuision of whole numbers, but also of Fractions, and almost in all the other rules belonging as well to Fractions, as to Integrums: Wherefore I would wish you often to vse your penne therein.

Hauing hitherto treated of the 4. speciall kinds of Arithmetike, that is of Addition, Subtraction, Multiplycation and Diuision, as well belonging to whole numbers, as to Fractions, and also shewed the vse of the Golden rule, otherwise called the rule of 3. and of all the three kinds thereof, that is the common rule, the rule Reuerse, and the Double rule, and giuen examples, how and when euery one is to bee vsed, together with the rule of Fellowship, necessarie for them that vse any trade of Marchandize, I thinke good now to speake somewhat of Arithmeticall and Geometricall progression, and also of Proportion, and of the three kinds thereof, that is Arithmeticall, Geometricall, and Musicall proportion, and then of the extraction of Rootes both square and Cubicall, and last of all, of Astronomicall Fractions, shewing how they are to be added, Subtracted, Multiplyed and diuided.

Of Progression and how manifolde it is.

Cap. 13.

WHat is Progression?

It is a certaine order of proceeding with diuers numbers in such sorte as euery one may exceede each other, either by like difference of quantitie, or else by like-

likenesse of Proportion, whereof springeth 2. kinds of Progression, the one called Arithmeticall, and the other Geometricall.

What is Arithmeticall Progression?

It is that which procedeth by like difference of quantitie, as thus, 3.5.7.9.11.13. whereof euery one excedeth his fellow by the difference of 2.

What is Progression Geometricall?

It is that wherein euery number excedeth his fellow by like proportion, for as 6. containeth 3. twise, so doth 12. containe 6. twise, &c.

Of Addition belonging to Progression Arithmeticall.

Cap. 14.

HOw are numbers being set in order according to Progression Arithmeticall, to be added together and to be reduced into one totall summe?

Thus, first see how many seuerall numbers there bee in all, and note the Summe by it selfe, then adde the first number of the Progression to the last thereof, and note that Summe by it selfe, that done, Multiply the one of these 2. reserued Summes by the one halfe of the other, and you shall haue the totall Summe. As for example let this be your Progression 6.10.14/18/22/26/30/34/ wherein euery number excedeth his fellow by the difference of 4. here hauing tolde the numbers, I finde them to be 8. which I set downe by it selfe, then I adde 6. which is the first number to 34. which is the last, and the Summe thereof is 40. which I also set downe by it selfe, then in Multiplying 40. by 4. which is the one halfe of 8. before set downe a part by it selfe, I finde the totall Summe of the Progression to bee 160.

Of Addition belonging to progresion Geometricall.

Cap. 15.

HOw are numbers being set in order according to Progresion Geometricall, to bee added and bee brought into one Summe.

Thus, Multiply the last Summe of the progression by the number of the proportion whereby such progression proceedeth, and from the product of that Multiplycation, Subtract the first number of the progression, that done, diuide that which remaineth by a number which is lesse then the proportion by one, and the quotient of such Diuision shall shew you the totall Summe of the said progression. As for example, let this bee the progression 2.6.18.54.162.486.1458. the proportion of which progression is tryple, wherefore according to the rule, I Multiply the last number of ỳ progression by 3. & the product of such Multiplycation amounteth to 4374. out of which Summe I Subtract the first number which is 2. and there remaineth 4372. which I diuide by 2. (for it is lesse then the proportion 3. by 1.) and so I finde in the quotient 2186. which is the totall Summe of the progression Geometricall.

Is there no briefer way of adding such kinds of progresion?

Yes indeede, but not so plaine as this way is, and therefore I thinke not good to trouble your memorie therwith.

Of Proportion.

Cap. 16

WHat is Proportion?

Proportion is taken generally for the comparing of two diuers quantities or numbers together, shewing what likenesse is betwixt them. But before wee deale

deale with Proportion, and with the three kindes thereof, that is Proportion Arithmeticall, Geometricall, and Musicall: You haue first to vnderstand, that of numbers some are said to bee abstract, and some concreate.

The abstract are such as are not tyed to any denomination, and such are twofold, that is absolute and relatiue.

The absolute, are simply pronounced without hauing any relation to any other number, measure, or quantitie, as 2.3.4. &c. and all numbers whatsoeuer, that are without denomination and are not attributed to any other thing.

The relatiue are those which haue relation one to another, which may be three manner of waies. First in respect of difference which is found by Subtraction, secondly in respect of the quotient found by Diuision, thirdly in respect of both. Of the first way springeth Arithmeticall proportion: Of the second way Geometricall proportion: And of the third Musicall proportion.

Cap. 17.

WHat is a Arithmeticall proportion

Arithmetical proportion improperly so called, (because it is no proportion indeed) is when many seuerall numbers haue one selfe and like difference, as 8.12.16. which doe onely differ one from another by 4. and this proportion is twofold, that is continuall and disiunct.

Continual is when many numbers proceede with like difference as hath beene said before when wee spake of Arithmetical Progression, as 8.12.16.20. &c. whose difference betwixt euery 2. numbers is 4.

The Disiunct, is when many numbers being seuerally propounded, the difference of the first 2. numbers is not like to the difference that is betwixt the second and the third, and so forth as 5.8.4.7. for 8. differeth from 5. by 3. and 4. from 8. by 4. and 7. from 4. by 3. Now of the second way of comparing which is done by Diuision, springeth as hath beene saide before, Geometricall proportion.

Cap. 18.

WHat is Geometricall proportion?

Geometrical proportion is that which sheweth what part or partes one number is of another number, as 3. is the halfe of 6. which proportion is found by Diuision, wherein you haue to note that if the Diuisor bee greater then the diuidend, then it is to be made a Fraction, as in the former example, if you would diuide 3. by 6. then you must make it a Fraction thus, $\frac{1}{2}$ or $\frac{3}{6}$ and this kind of proportion which may be truely and properly called a proportion indeed or rather a proportionalitie, is said to be twofold, that is, direct, and reuerse, and the direct is either Coniunct, or Disiunct.

Coniunct differeth not from Geometricall Progression before taught.

Disiunct proportion Geometricall, consisting most commonly of 4. numbers or of 3. at the least, is when there is not like proportion betwixt the second and the third, that is betwixt the first and the second, or betwixt the third and the fourth, as 3.6.4.8. for here 6. containeth 4. once, and one halfe thereof, which is called Proportio Sesquialtera, and 6. containeth 3. twise, which is called Proportio dupla: and so is 8. to 4.

Cap. 19.

AGaine, proportion Reuerse differeth not from the rule of 3. called Regula euersa. But you haue to vnderstand that the two chiefe and speciall kinds of Geometricall proportion, are these, that is, proportion of equalitie, and proportion of inequalitie.

Proportion of equalitie, is when 2. numbers compared together, are equall the one to the other, as 3 to 3. 4. to 4.

The proportion of inequalitie, is when 2. vnequal numbers are compared together, as 6. to 5. 4. to 9. and of this there are two

kinds, that is proportion of the greater inequalitie, and proportion of the lesser inequalitie.

Cap. 20.

PRoportion of the greater inequalitie, is when the greater number is compared to the lesser number, as 6. to 5.

PRoportion of the lesser inequalitie, is when the lesser is compared to the greater, as 5. to 6.

Of proportion of the greater inequalitie there bee two kindes, Simplex and Multiplex, that is to say, simple and manifold.

SImpler, is when the Antecedent, that is to say the former number containeth the consequent, that is to say the latter number once and somewhat more, which ouerplus must alwaies bee lesse then the consequent it selfe, as 5. containeth 4. once and one part thereof more, for if you diuide 5. by 4. the quotient will be 1. and $\frac{1}{4}$ ouer. Againe this proportion is twofold, that is Superparticular, and Superpartient: Superparticular, is when the Antecedent containeth the consequent once and some one part thereof, as 3. to 2. for 3. containeth 2. once and one halfe thereof, which is called Sesquialtera, or as 4. to 3. for 4. containeth 3. once and one third part thereof, and is called Sesquitertia, the like is to be said of Sesquiquarta, Sesquiquinta, Sesquisexta, and so forth infinitely as this Table sheweth.

Superparticular proportiõs are these & such like.	Sesquialtera as 3. to 2. 6. to 4. 9. to 6.	$1\frac{1}{2}$
	Sesquitertia as 4. to 3. 8. to 6. 12. to 9.	$1\frac{1}{3}$
	Sesquiquarta as 5. to 4. 10. to 8. 15. to 12.	$1\frac{1}{4}$
	Sesquiquinta as 6. to 5. 12. to 10. 18. to 15.	$1\frac{1}{5}$
	Sesquisexta as 7. to 8. 14. to 12. 21. to 18.	$1\frac{1}{6}$
	Sesquiseptima as 8. to 7. 16. to 14. 24. to 21.	$1\frac{1}{7}$
	Sesquioctaua as 9. to 8. 18. to 16. 27. to 24.	$1\frac{1}{8}$
	Sesquinona as 10. to 9. 20. to 18. 30. to 27.	$1\frac{1}{9}$
	Sesquidecima as 11. to 10. 22. to 20. 33. to 30.	$1\frac{1}{10}$
	Sesquiũdecima as 12. to 11. 24. to 22. 36. to 33.	$1\frac{1}{11}$
	Sesquiduodec. as 13. to 12. 26. to 24. 39. to 36.	$1\frac{1}{12}$

which is as much as.

But

But superpartient is when the Antecedent containeth the consequent once and some parts therof, that is to say more parts then one, as 5. to 3. for 5. containeth 3. once and 2. third parts thereof, which is called Superbipartiens tertias, of which kinds are these set downe in the Table following.

Proportions superpartient are these and such like.

Superbipartiens.	Tertias	as 5. to 3. 10. to 6. 15. to 9.	which is as much as.
	Quintas	as 7. to 5. 14. to 10. 21. to 15.	
	Septimas	as 9. to 7. 18. to 14. 27. to 21.	
	Nonas	as 11. to 9. 22. to 18. 33. to 27.	
	Vndecimas	as 13. to 11. 26. to 22. 39. to 33.	
	Decimas tertias	as 15. to 13. 30. to 26. 45. to 39.	
Supertripartiens.	Quartas	as 7. to 4. 14. to 8. 21. to 12.	which is as much as.
	Quintas	as 8. to 5. 16. to 10. 24. to 15.	
	Septimas	as 10. to 7. 20. to 14. 30. to 21.	
	Octauas	as 11. to 8. 22. to 16. 33. to 24.	
	Decimas	as 13. to 10. 26. to 20. 39. to 30.	
	Vndecimas	as 14. to 11. 28. to 22. 42. to 33.	
Superquadripartiens.	Quintas	as 9. to 5. 18. to 10. 27. to 15.	which is as much as.
	Septimas	as 11. to 7. 22. to 14. 33. to 21.	
	Nonas	as 13. to 9. 26. to 18 49 to 27.	
	Vndecimas	as 15. to 11. 30. to 22. 45. to 33.	
	Decimas tertias	as 17. to 13. 34. to 26. 51. to 39.	
	Decimas quintas	as 19. to 15. 38. to 30. 57. to 45.	
Superquintupartiens.	Sextas	as 11. to 6. 22. to 12. 33. to 18.	which is as much as.
	Septimas	as 12. to 7. 24. to 14. 36. to 21.	
	Octauas	as 13. to 8. 26. to 16. 39. to 24.	
	Nonas	as 14. to 9. 28. to 18. 42. to 27.	
	Vndecimas	as 16. to 11. 32. to 22. 48. to 33.	
	Duodecimas	as 17. to 12. 34. to 24. 51. to 36.	
Supersextupartiens.	Septimas	as 13. to 7. 26. to 14. 39. to 21.	which is as much as.
	Vndecimas	as 17. to 11. 34. to 22. 51. to 33.	
	Decimas tertias	as 19. to 13. 38. to 26. 57. to 39.	
	Decimas septimas	as 23. to 17. 46. to 34. 60. to 51.	
	Decimas nonas	as 25. to 19. 50. to 38. 75. to 57.	
	Vicesimas tertias	as 29. to 23. 58. to 46.	

Hitherto

Hitherto of Simplex proportio. Now of Multiplex proportio.

Multiplex proportio is when the Antecedent containeth the consequent more then once, as 6. to 2. for 6 containeth 2. three times, which is called Tripla proportio. Also 12. to 5. for 12. comprehendeth 5. twise and $\frac{2}{5}$. And this Multiplex proportio is twofolde, that is either exact or not exact.

Multiplex exact, is when the Antecedent containeth the consequent more then once, and nothing remaineth, as 4. to 2. 6. to 3. &c. whereof are infinite kinds, as Dupla, Tripla, and so forth as this Table sheweth.

The kinds of Multiplex exact are these and such like.

Dupla	as 4. to 2. 6. to 3. 8. to 4.	which is as much as.
Tripla	as 6. to 2. 9. to 3. 12. to 4.	
Quadrupla	as 8. to 2. 12. to 3. 16. to 4.	
Quintupla	as 10. to 2. 15. to 3. 20. to 4.	
Sextupla	as 12. to 2. 18. to 3. 24. to 4.	
Septupla	as 14. to 2. 21. to 3. 56. to 8.	
Octupla	as 16. to 2. 24. to 3. 32. to 4.	
Nondupla	as 18. to 2. 27. to 3. 36. to 4.	
Decupla	as 20. to 2. 30. to 3. 40. to 4.	
Undecupla	as 22. to 2. 33. to 3. 495. to 45.	

$\frac{2}{1}$ $\frac{3}{1}$ $\frac{4}{1}$ $\frac{5}{1}$ $\frac{6}{1}$ $\frac{7}{1}$ $\frac{8}{1}$ $\frac{9}{1}$ $\frac{10}{1}$ $\frac{11}{1}$ &c.

But Multiplex not exact, is when the Antecedent containeth the consequent more then once and some thing remaineth ouer, as 5. to 2. for 5. containeth 2. twise and one remaineth, and this is also twofolde, that is, Multiplex superparticularis, and Multiplex superpartiens.

Multiplex superparticularis, is when the Antecedent containeth the consequent more then once and one only remaineth, as 7. to 3. for 7. containeth 3. twise and one only remaineth, whereof are diuers kinds, as Duplex sesquialtera, Duplex sesquitertia, Triplex sesquisexta, & so forth as ꝑ table hereafter following sheweth

But Multiplex superpartiens, is when the Antecedent containeth the consequent more then once & the remainder is more then 1. as 8. to 3. for 8. containeth 3. twise and 2. thirds ouer, whereof there be many kinds, as *Dupla superbipartiens tertias*, Dupla supertripartiens quartas, and so forth as this Table following sheweth, which comprehendeth both kinds, that is Multiplex superparticularis, and Multiplex superpartiens.

Multiplex

Multiplex not exact, is either

Multiplex Superparticularis or els

- Duplex.
  - Sesquialtera as 5. to 2. 15. to 6.
  - Sesquitertia as 7. to 3. 21. to 9.
  - Sesquiquinta as 11. to 5. 22. to 10.
- Triplex.
  - Sesquisexta as 19. to 6. 38. to 12.
  - Sesquiseptima as 22. to 7. 44. to 14.
  - Sesquioctaua as 25. to 8. 50. to 16.
- Quadruplex.
  - Sesquinona as 37. to 9. 148. to 36.
  - Sesquidecima as 41. to 10. 82. to 20.
  - Sesquiundecima as 45. to 11. 90. to 22.

which is. $2\frac{1}{2}$ $2\frac{1}{3}$ $2\frac{1}{5}$ $3\frac{1}{7}$ $3\frac{1}{7}$ $3\frac{1}{8}$ $4\frac{1}{9}$ $4\frac{1}{10}$ $4\frac{1}{11}$

Multiplex Superpartiens.

- Dupla.
  - Superbipartiens.
    - Tertias as 8. to 3.
    - Quintas as 12. to 5.
  - Supertripartiens.
    - Quartas as 11. to 4.
    - Quintas as 13. to 5.
  - Superquadripartiens
    - Quintas as 14. to 5.
    - Septimas as 18. to 7.
  - Superquintupartiens.
    - Octauas as 29. to 8.
    - Nonas as 34. to 9.
  - Supersextupartiens.
    - Vndecimas as 39. to 11.
    - Decim. tertias as 45. to 13.
  - Superseptupartiens.
    - Octauas as 31. to 8.
    - Nonas as 34. to 9.
- Tripla.
  - Superbipartiens.
    - Tertias as 14. to 3.
    - Quintas as 22. to 5.
  - Superquadripartiens
    - Quintas as 24. to 5.
    - Nonas as 40. to 9.
  - Superquintupartiens.
    - Sextas as 29. to 6.
    - Septimas as 33. to 7.

which is. $2\frac{2}{3}$ $2\frac{2}{5}$ $2\frac{4}{7}$ $2\frac{4}{7}$ $3\frac{5}{8}$ $3\frac{5}{9}$ $3\frac{6}{11}$ $3\frac{6}{13}$ $3\frac{7}{8}$ $3\frac{7}{9}$ $4\frac{2}{3}$ $4\frac{2}{5}$ $4\frac{4}{5}$ $4\frac{4}{9}$ $4\frac{5}{6}$ $4\frac{5}{7}$

Thus much of proportion of the greater inequalitie: Now wee will speake somewhat of proportion of the lesser inequalitie.

Proportion

Cap. 21

PRoportion of the lesser inequalitie, is when the Antecedent is lesse thē the consequent, as 2. to 3. 5. to 7. for if you diuide 2. by 3. the quotient is $\frac{2}{3}$ if 5. by 7. then the quotient is $\frac{5}{7}$ and this Proportion hath the same names which the Proportion of the greater inequalitie hath, sauing that you must adde to the beginning of euery name, this word, Sub. as Subdupla, Subtripla, Subsesquialtera, &c. as 1. to 2. is Subdupla proportio, 3. to 9. is Subtripla proportio, &c.

Of Musicall proportion called in Latine *Harmoniaca proportio.*

Cap. 22.

MUsicall proportion which requireth 3. numbers at the least, is when the first number hath the same proportion vnto the third, which the difference betwixt the first and the second, hath to the difference which is betwixt the second and the third, as 3. 4. and 6. for loke what proportion 3. hath to 6. which is Subdupla, the same hath the difference betwixt 3. and 4. which is 1. to the difference betwixt 4. and 6. which is 2. for 1. to 2. is Subdupla, and this is called Musicall proportion, because the numbers therein haue the same proportions one to another, which are found to be in Musicall consorts, as 6. 4. and 3. for the proportion which 6. hath to 4. is Sesquialtera, called of the Musitians Diapente, or a fift, and the proportion which 4. hath to 3. is Sesquitertia, called of the Musitians *Diatesseron*, or a fourth, and the

pro-

proportion which 6. hath to 3. is Dupla, called a Diapason, or an Eight, and of this Musicall proportion there be two kinds, that is simple and compound.

It is said to be simple when it consisteth onely of 3. numbers.

And it is called compound when it consisteth of more then 3. numbers: And of compound there be two kinds, that is vnproper and proper.

The vnproper is, when to 3. numbers giuen, 2 other seuerall numbers are ioyned, which doe containe the same proportions with the third, which the first 3. numbers haue one to another: As for example, let be giuen these 3. numbers, 3. 4. 6. vnto which if you ioyne 8. and 12. here 6. 8. 12. haue the same proportion one to another which 3. 4. and 6. haue amongst themselues, for like as here betwixt 6. and 8. the proportion is Subsesquitertia, and betwixt 6. and 12. it is Subdupla, and betwixt 8. and 12. it is Subsesquialtera, so betwixt 3. and 4. is Subsesquitertia, and betwixt 3. and 6. is Subdupla, and betwixt 4. and 6. is Subsesquialtera.

Compound proper, is when diuers numbers in Musicall proportion standing together, and the first being omitted, the 3. next doe continue still in Musicall proportion. Also when omitting the 2 first numbers the 3. next following are in Musicall proportion. And when omitting the first 3. the next 3. are in Musicall proportion, and so forth how many numbers so euer there be: As for example 10. 12. 15. 20. 30. these are numbers belonging to the proper kind of compound Musicall proportion, for 10. 12. and 15. are in Musicall proportion, then omitting 10. which is the first number 12. 15. and 20. are still in Musicall proportion, and if you omit the 2. first numbers, that is 10. and 12. then the next 3. that is 15. 20. and 30. are still in Musicall proportion, and so forth how many so euer there be of them, so as they be in Musicall proportion: But our Musitians doe make no more but 8. Musicall proportions in all, that is.

Dupla.	which are thus named	Diapason.
Tripla.		Diapason diapente.
Quadrupla.		Bis diapason.
Sesquialtera.		Diapente.
Sesquitertia.		Diatesseron.
Sesquiquarta.		Diatonus semitonus.
Dupla superbipartiens.		Diapason diatesseron.
Sesquioctaua.		Tonus.

The vse whereof is to bee learned at the handes of the Musitians.

Cap. 23.

BVt now because it is not inough to knowe the foresaid proportions and their names, vnlesse you can both adde, Subtract, Multiply, and diuide them when nede is, I will therefore briefly heere set downe the order thereof, and first shewe how to set them downe in writing, and then how they are to be added, Subtracted, Multiplyed, and diuided.

They are to be set downe in writing in like manner that Fractions are wont to bee set downe, sauing that as in Fractions the vpper number is called Numerator, and the inferior number Denominator, so in proportions the vpper number is called Antecedent, and the inferior number Consequent, but whereas in Fractions, ther is wont to be drawn a litle line betwixt the Numerator and the Denominator, in proportions no line is drawne betwixt the Antecedent and the Consequent, but the Antecedent is set ouer the Consequent, without any line drawne betwixt them thus.

And looke as Fractions are to be written in as fewe figures as may be, so are proportions to be set down in so small numbers as may be, which is to be done by the selfe same rule that Fractions are.

3.	4.	2.
5.	7.	1.

Againe the order of adding, Subtracting, Multiplying and diuiding of proportions is much like to that of Fractions, sauing that

that the adding of proportions is to bee done in ſuch manner as Fractions are to be multiplyed, and the Subtracting of proportions is like to the Diuiſion of Fractions, wherefore I wholly referre you to the rules of Fractions before moſt plainely taught, and ſo I end with proportions.

Notwithſtanding I had almoſt forgotten to ſet downe one neceſſarie Rule more touching proportions, which was alſo omitted in the firſt Impreſſion, that is, how to finde out the meane proportionall number betwixt any two numbers giuen, which Rule is thus, multiply the two numbers giuen the one by the other, and the ſquare Roote of the product ſhall bee the meane proportionall number betwixt them. As for example, ſuppoſe the two numbers giuen to bee 9. and 36. which being multiplyed the one into the other, the product will be 324. the ſquare Roote whereof is 18. and that is the meane proportionall number betwixt the foreſaid numbers giuen. Now how to take the ſquare Roote of any number is plainely taught in the 24. Chapter next following.

How to finde out the ſquare Roote of any number.

Cap. 24.

WHat is a ſquare Roote?

It is any Digit or anye other number, which being multiplyed into it ſelfe bringeth forth a ſquare number, as 4. being multiplyed in it ſelfe, in ſaying 4. times 4. maketh 16. which is a ſquare number, the Roote whereof is 4. And to finde out the ſquare Roote of any number be it ſquare or not ſquare, you muſt doe thus. Firſt hauing ſet downe the number propounded which muſt conſiſt of 3. figures at ỹ leaſt, ſet a pricke vnder the firſt Digit or Cypher of the ſaid number on the right hand, that done, pricke euery other figure thereof towards the left hand, leauing alwaies one voide ſpace betwixt euery 2. pricks as you ſée here done in this

number

number 4.2.1.6.4. and loke how many prickes there be, so many figures shall you haue in the quotient, and this differeth nothing in a manner from Diuision, the order in working is thus, first seke out a Digit, which being multiplyed in it selfe, may take away that which standeth ouer the last pricke on the left hand, or as much therof as may be, and set the Digit in the quotient, that done, double the said quotient, then consider whether the double doe consist of one figure or of many, if of one onely, then place that in the next voide space on the right hand, but if the double doe consist of many figures, then take the first figure thereof, that is to say, that figure or Cypher which standeth in the first place of the double, and place that in the foresaide next voide space towards the right hand, and next to that, place all the rest of the figures of the saide double orderly towards the left hand, that done, seke another Digit, which being multiplyed in it selfe together with the doubled number, may take away all that which standeth right ouer it, or as much therof as may be, which Digit you must not onely put in the quotient to his fellow, but also set downe the same right vnder the nert pricke on the right hand, and then multiply that Digit together with the double whereto it is ioyned, by the said last found Digit set downe in the quotient, the product whereof you must subtract out of the vpper number, standing right ouer the foresaid pricke, and if ther be any remainder, write it aboue, cancelling the other, and loke how many pricks ther be, so many times must you double the quotient, obseruing alwaies like order of working as before, which you shall more plainely vnderstand by these examples following, and for your better vnderstanding thereof, I will first giue you an example of 3. figures onely as thus, 464. here to finde out the square roote of this number, you must first pricke the said number in such order as is before taught, and then seke out some one of the 9. Digits, which being multiplyed in it selfe, may take away the first 4. on the left hand, or as much therof as may be, which you shall finde to be 2. which 2. being set in the quotient multiply the same in it selfe, in saying 2. times 2. maketh 4. which 4. doth cleane take away the first 4. standing ouer the last pricke on the left hand, and therefore cancell the 4. that done, double the quotient which maketh 4. and set the same in the next voide space on the right hand vnder the figure 6. thus.

And then ſeeke out ſome Digit, which being multiplyed in it ſelfe together with the doubled, may take away the Summe of 64. that remaineth, which by aſking how many times 4. is comprehended in 6. you ſhall finde to be but one, which you muſt not onely put in the quotient, but alſo ſet it downe vnder the firſt pricke on the right hand thus.

So as you ſhall make the lower Summe to be 41. which is to be multiplyed by the laſt found quotient which is 1. wherefore you muſt ſay that 1. times 41. is 41. which being taken out of 64. there remaineth 23. ſo as the rote is 21. and the remainder 23. as this example ſheweth.

And to know whether you haue done well or not, multiply the quotient in it ſelfe, and if there be any remainder left, adde that vnto the product of the multiplyed quotient, and if you finde the ſumme thereof to be like to the firſt, then you haue done well, if it be not like, then you haue erred, the product of this quotient being multiplyed in it ſelfe amounteth vnto 441. whereto by adding the remainder which is 23. you ſhall finde the ſumme to be like vnto the firſt number that is 464. whereof you ſought the ſquare rote. But if ſuch number do conſiſt of many figures, then in working you muſt double the quotient once, twiſe or thrice, according as the number doth require, as you ſhall more plainely perceiue by this example following: as let 50467. be the number whereof you would know the ſquare rote, here hauing pricked this number in ſuch order as before, firſt ſeeke out ſome Digit, which being multiplyed in it ſelfe may take away the Digit or number ſtanding right ouer the laſt pricke on the left hand, which you ſhall finde to bee 2. and hauing ſet downe the ſaide 2. in the quotient, ſaye 2. times 2. maketh 4. which being ſubtracted from 5. there remaineth 1. which you muſt ſet ouer 5. and cancell the ſaide 5. as this example ſheweth.

That done, double the quotient which maketh 4. and ſet downe the 4. in the next ſpace towards the right hand, vnder the Cypher as you ſee in the former example, then ſeeke out a Digit, which being multiplyed in it ſelfe together with the double quotient, may take away all that which ſtandeth ouer the ſecond pricke towards the left hand,

or as much thereof as may be, which Digit by asking how many times 4. is comprehended in 10. you shall finde to bee 2. then set downe the saide 2. not onely in the quotient, but also vnder the second pricke towardes the right hande, which together with the former 4. maketh 42. as you see in this example.

Then multiply that 42. in a place by it selfe by the figure 2. last set downe in the quotient, and it will make 84. which 84. being taken out of 104 there remaineth 20 which you must set ouer the second pricke and cancell the 104 and also the 42 beneath, as you see in the former example: that done, double the whole quotient, which maketh 44 whereof set the first 4 in the next voide space towards the right hand vnder the figure 6 and the other 4 vnder the second pricke towards the left hand, the aske how many times 4 is comprehended in 20 and you shall finde 4 which you must not onely set downe in the quotient, but also vnder the next and last pricke on the right hand, and so the nether Summe shall be 444 which being multiplyed by the Digit 4 last set downe in the quotient, will make in al 1776 which being taken out of the vpper number which is 2067 there will remaine 291 so as the square roote of the first number is 224 and the remainder 291 as you may see in this example.

```
X 20
5 0 4 6 7 (22
  · 4 2 ·
  ---
  8 4.
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The square roote whereof being multiplied in it selfe amounteth vnto 50176 whereto if you adde the remainder which is 291 the Summe thereof will bee like vnto the first number wich is 50467 Moreouer you haue to note that if you find any number out of the which your quotient being doubled cannot be subtracted, then you must set downe a Cypher in the quotient, and proceede to the next pricke on your right hand, as in this example following.

```
X 2
X 2 0 9 1
5 0 4 6 7 (224
· · 4
4 2 4
4
-------
1 7 7 6:
```

In which example the first found Digit set in the quotient is 6 which being multiplyed in it selfe maketh 36 and cleane taketh away the first number standing ouer the last pricke on the left hand, that done, I double the quotient, which maketh 12 and I place the 2 in the next voide space towardes the right hand, and the 1 next to that towardes

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3 6 6 0 2 5 (6
· · ·
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the left hand orderly as in this example.

Ouer which 12. there is but 6. remaining, so as I can not take 12. out of 6. and therefore I cancell the 12. and set down a Cypher in the quotient, so as the quotient is now 60. which being doubled maketh 120. the Cypher whereof I set downe in the next voide space towards the right hand, and the other two Digits orderly towards the left hand, as you see in this example.

3 6025 (60.
X2

Then I aske how many times one is contained in 6. and I finde 5. which I set downe in the quotient and also vnder the last pricke on the right hand, so as the nether number is 1205. which I multiply apart by it selfe by the 5. last set downe in the quotient, the product whereof is 6025. which being taken out of the vpper number, which is also 6025. there remaineth nothing, as this example sheweth.

3 6025 (60.
X20
12

Wherefore I finde the foresaid number to be a iust square number, the roote whereof is 605. which being multiplied in it selfe maketh 366025. a number like vnto the first number.

3 6 6 0 2 5 (605.
· X 2 0 5
6 0 2 5.

The vse of the square Roote in *setting of battels.*

Cap. 25.

THe knowledge of finding out the square roote of any number, is very necessarie for a Sargent maior in the fielde, that he may the more readily set and range his Squadrons of Battel: And therefore I thinke it not amisse, to giue them here certaine examples of such manner of squares as the Italians were wont to vse in my time which is foure manner of waies.

Whereof the first teacheth how to set the Battell square of ground,

ground, the second a square battel of men, the third a long square battel which wee call the Pearse battell, and the fourth teacheth how to set a battel of so much and a third.

Shew by what rule these battels are to be set?

Before I set downe any rules you haue to vnderstand that all numbers giuen or supposed, are not meete for such purpose, but onely such as may be diuided into 3. equall parts without leauing any remainder: for otherwise all the rules following, take no place, and therefore when any number is giuen you to be brought into any one of the foresaid 4. formes of battell, you shall doe well first to diuide that number by 3. and if there be any remainder, to reiect it, and to take the rest for your number, As for example, A Sargent Maior is commanded by his Generall to set a battell square of ground, appointing him thereunto 1345. men, here the Sargent by diuiding that number by 3. findeth in the remainder one man too many, which being onely reiected, all the rest of the number which is 1344. is fitte for his purpose.

How to set a battell square of ground, called in Italian Battaglia quadra di terreno.

NOw shew the order of setting such kinds of battell

The order is thus, first double the number giuen, then take the square roote thereof, and that roote shall bee the Front: that done, diuide the number giuen by the said roote, and the number in the quotient shall bee the flanke, now if you multiply the front and the flanke the one into the other, you shall haue your whole number first giuen, vnlesse there bee some remainder left in the former Diuision, which remainder must bee added to the product to make vp the Summe. But if you would know how many men are to be put in a rancke, and also how many such rancks you must haue, then diuide the front into 3. partes, and the quotient will shew you how many men you are to haue in a rancke, that done, multiply the flancke by 3. and the product thereof shal be the number of the rancke: As for example, take the number before giuen, which was 1345. which being diuided by 3. you finde the remainder to bee 1. which you must reiect, and take all the rest which is

1344. and that being doubled maketh 2688. the square Rote whereof is 51. by which rote you must diuide the number giuen, Videlicet 1344. and the quotient will be 26. which shall bee the flancke, now if you diuide the foresaid front 51. by 3. the quotient will shew how many shall be in a rancke, that is 17. Finally, if you multiply the flancke, which is 26. by 3. the product thereof will be 78. which is the iust number of the rancks which you must haue.

How to set a battell square of men called in Italian.
Battaglia quadra d'huomini.

TAke the square rote of the number giuen, and that shall bee both the front and the flanck, which if you multiply together, the product thereof will make vp the number first giuen, and if you would know how many men are to bee put in a rancke, and how many such rancks you must haue, then doe as you did before in diuiding the front by 3. and multiplying the flancke by 3.

How to set a long square battell which wee call the Hearse battell, and is called in Italian, Battaglia dun tanto emezzo.

TO the number giuen, adde the iust halfe therof, and the square rote of that Summe shal be the front, by which rote, or front if you diuide the first number giuen, the quotient shall bee the flancke: As for example, let the number giuen be 6144. the halfe thereof is 3072. which being added to the giuen number 6144. maketh in all 9216. the square rote whereof is 96. which shal be the front, by which rote or front if you diuide the giuen number 6144. you shall finde in the quotient 64. and that shall bee the flancke, that done, diuide the foresaide front 96. by 3. and you shall finde in the quotient 32. which number sheweth how many men shall be in a rancke, then multiply the foresaid flancke 64. by 3. and the product thereof shall bee 192. which is the number of the rankes.

How

How to set a battell of so much and a third, called in Italian, Battaglia dun tanto & dun terzo.

TO the number giuen, adde the third part thereof, & the square roote of that Summe shall bee the front: then diuide the first number giuen by the foresaid roote or front, and the number in the quotient shall be the flancke: As for example, let the number giuen be 1575. the third part whereof is 525. which being added to 1575. maketh in all 2100. the roote whereof is 45. which must be the front, by which roote or front, if you diuide the number giuen which was 1575. the quotient will be 35. which shall be your flancke, then by diuiding 45. which is the front by 3. the quotient wil shew you how many men you must haue in a rancke that is 15. Againe by multiplying the flancke which is 35. by 3. the product thereof will be 105. which is the number of your rankes.

How to finde out the Cubique *Roote of any number.*

Cap. 26.

AS the square roote is said to bee a number which being multiplyed in it selfe, doeth make a square superficiall number, hauing onely length and breadth, so the Cubique Roote is a number which being first multiplyed in it selfe, and the product therof being againe multiplyed by the first number, doth make a Cubique or Corporall number hauing both length breadth, and depth: As for example, 2. times 2. maketh 4. and 2. times 4. maketh 8. Againe 3. times 3. maketh 9. and 3. times 9. maketh 27. and so you may deale with all the rest of the 9. Digits, and make thereby a Table containing both the square numbers and Cubique numbers

of euery roote, consisting of any one of the 9. Digits, like vnto this table here followinge:

Rootes	Squares	Cubiques
1.	1.	1.
2.	4.	8.
3.	9.	27.
4.	16.	64.
5.	25.	125.
6.	36.	216.
7.	49.	343.
8.	64.	512.
9.	81.	729.

Then hauing to finde out the Cubique roote of any number that is greater then 1000. (for lesser it cannot be to worke vpon) then set a pricke vnder the first figure on your right hand, and so procéede towards the left hand, omitting alwaies 2. figures betwixt euery two prickes, as in this example 41063625. and looke how many prickes there bee, so many figures shall you haue in the quotient: That done, you haue to finde out three seuerall numbers, first such a Cubique number as well cleane take away the number which standeth right ouer the head of the last pricke on the left hand, or so much thereof as may be, which you may easily find in the foresaid table: The roote of which Cubique number, you must set downe in the quotient, the second number which you haue to find is a number called the Triple, which is easily had by tripling the quotient, and the third number is called the Diuisor which you shall most readily finde by multiplying the quotient into the Triple, both which numbers are to be placed in such order as followeth. First then hauing found the Cubique number as is before said, and taken the same out of the number standing ouer the last pricke on the left hand, write the remainder (if there be any) ouer his head, cancelling that which is vnder it, and then place the roote of the said Cubique number in the quotient: that done, Triple the roote set downe in the quotient, and that shall be the Triple which you must place in the second voide space on the left side of the next pricke which is on your right hand, then multiply that Triple by the quotient, and the product thereof shall be the Diuisor which must bee placed right vnder the Triple one figure shorter towards the left hand: that done, drawe a line as you sée in the example hereafter following and worke thus: First aske how many times the first figure of the saide Diuisor is contained in the number standing right ouer his head: and hauing found an apt

Digit

Digit for the purpose, put that Digit in the quotient to his fellow, that done, multiply the said Digit into the Diuisor and set the product thereof right vnder the Diuisor: Secondly multiply the said Digit in him selfe, and againe the product thereof into the triple, & set the summe ỳ comes therof right vnder the triple: Thirdly multiply the said Digit in it selfe cubically, and set the product thereof lowest of all, right vnder the next pricke on the right hand: that done, drawe a line, and by Addition bring all the foresaid thré products into one summe placing euery figure so as you may easily take the said summe out of the vpper number, whereof you séeke the Cubique roote, and write the remainder (if there be any) ouer the head, and if such summe will not bee subtracted out of the vpper number, then you must séeke out a lesser Digit, reseruing still the former triple and Diuisor, and if there bee more pricks in the number then two, then you must for euery pricke finde out a new Triple, and a new Diuisor by tripling the whole quotient, and by working continually in like order as the rule before teacheth, which rule you shall more plainly perceiue by example thus. First then hauing to finde out the Cubique roote of the number before mentioned, which is 41.063625, marked with prickes as before is taught: resorte to the Table wherein you shall finde such a Cubique number as will take away as much of the 41. as may bee, which is 27. the roote whereof is 3. for al the other Cubique numbers in the table are either too small or too great, and therefore you must alwaies haue due consideration therof. Then take 27. which is the Cubique number, out of 41. and there remaineth 14. which remainder yeu must set ouer the last pricke on you left hand cancelling the 41. as in this example.

Then triple the quotient which maketh 9. 14
which you must set downe vnder the figure 41.063625 (3.
6 next vnto the second prick which is on your
right hand. Then to find out ỳ Diuisor multiply the Triple 9. by 3. which is the quotient, and the product therof shal be ỳ Diuisor. which diuisor you must place right vnder the triple one figure shorter towards the left hand: that done, draw a line as you sée in this example.

Now

Now hauing orderly set downe the Triple and the Diuisor, aske how many times 2. which is the first figure of the Diuisor is contained in 14. standing right ouer his head, and remember to make choise of such a Digit as may not cleane take away the whole number at the first, but rather leaue so much as the said quotient hauing afterward to be multiplyed diuers waies as shal be said hereafter, may take away the rest or as much therof as may be, as in this example following, you shall finde the aptest Digit for this purpose to be 4. which you must put in the quotient wherby the quotient shall be now 34. that done, you must first multiply this last quotient which is 4. into the Diuisor 27. the product whereof is 108. which you must set downe right vnder the Diuisor, beneath the line already drawne, as you see in this example.

```
          14
      4X063625 (3.
Triple—|9
Diuisor—27
```

Secondly you must multiply the said 4. in it self quadratly which maketh 16. then multiply that 16. by the triple 9. the product whereof is 144. which is to bee set right vnder the triple as in this example.

```
          14
      4X063625 (34.
Triple—|9
Diuisor—27.
-----------
       108
```

Thirdly you must multiply the said 4. in it selfe cubically, which maketh 64. which is to bee set right vnder the next pricke on the right hand beneath the former summes as you see in this other example.

```
          14
      4X063625 (34.
Triple—|9
Diuisor—27|
-----------
       108|
        144
```

So as euery one of the foresaide three products doe extend one further then another by one figure towardes the right hand, as you see in ỹ former example: Now these products being thus placed, drawe another line and bring all the three seuerall products contained betwixt the 2. lines, into one summe by Addition, and you shal

```
          14
      4X063625
Triple    9
Diuisor  27||
-------------
       108||
        144|
          64
```

finde

finde the totall summe to be 12304. which being subtracted out of the number standing right ouer it which is 14063. there will remaine 1759. which you must set downe aboue as you see in this example.

Now to proceede with the next, you must finde out a new Triple and a new Diuisor.

How is that done?

	1
	X4759
	4X0632625(34
Triple	9.
Diuisor 27	| |
	108 | |
	144 |
	64
	12304

Thus, multiply the whole quotient which is 34. by 3. the product whereof is 102. and that is the Triple which is to bee placed in the next voide space hard by the next pricke that is on your right hand: Then multiply the whole quotient into the last found Triple 102. and the product thereof which is 3468. shall bee your Diuisor, which is to be placed vnder the Triple one figure shorter towards the left hand as you see in the example following: which two numbers being thus found and rightly placed, draw a line, then aske how many times the first figure of your Diuisor which is 3. is contained in the number right ouer his head which is 17. and you shall finde it to bee 5. times contained therein, wherefore set downe 5. in the quotient, that doone, multiply the 5. into the Diuisor, and place the product thereof which is 17340. right vnder the Diuisor beneath the line, as you see in this example.

Secondly square the same 5. that is to say, multiply it in it selfe, and that maketh 25. which 25. you must multiply againe into the Triple 102. the product whereof is 2550. which number you must set right vnder the saide triple beneath the line. Thirdly multiply the saide 5. in it selfe Cubically which maketh 125. and place that right vnder the first pricke on the right hande, and drawe a line: that done, adde all the foresayde 3. products together, and you shall finde the totall summe thereof to bee 1759625. which being subtracted out of the vp-

	1
	X4759
	4X0632625(349
Triple	102
Diuisor	3463
	17340

per

per number, there remaineth nothing, as this example plainely sheweth.

Whereby you may conclude that the forsaid number wherof you sought the roote, is a perfect Cubique number, for if you multiply the whole quotient in it selfe cubically, it wil produce the selfe same number whereof you sought the roote. But note that if in making the first Subtraction, the first Diuisor is not to bee found in the vpper number, then you must set a Cypher in the quotient, that done, triple the whole quotient, and place the saide Triple vnder the figure which is next to the next pricke on the right hand, working in such order as before, and to auoide confusion hauing to deale with a multitude of numbers it shall not bee a misse at the finding out of euery new Triple, and Diuisor to set the remainders in seuerall places by themselues, and to worke them in the selfe same order that is before taught, also note that if you haue to deale with a fewe numbers, and that the diuisor cannot be subtracted out of the number standing right ouer his head, then you must set a Cypher in the quotient and so you haue done, as for example, hauing to take the cubicall roote of 8597. here I find 2. to bee the quotient, which being cubically multiplyed, doth cleane take away the 8. and now according to my former rule 12. must be my Diuisor, which because I cannot take it out of 5. I set downe therefore a Cypher in the quotient, so as the quotient is now 20. which is the cubicall roote of the foresaide number, for if you multiply 20. cubically and adde thereunto 567. which is the remainder, the summe thereof will bee like vnto the first number, as you may see in this example.

```
                                  x
                               x x x
                            x x x x x
                         x x x x x x x x (345
                            Triple  102
                         Diuisor 3458
                                 17340
                                  2550
                                   125.
                         1759625
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8567.                                  20
                                       20
                                      400
                        6 Triple (20
                   12   Diuisor        2
                                     8000
                                      567
                                     8567
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Of

Of Astronomicall Fractions.

Cap. 27.

BEcause the vse of these Fractions is very necessarie for those that haue to calculate the motions of the Starres and the difference of time, I thought good to shew here how the same are to be added, subtracted, multiplyed and diuided, for the measure of time falleth not out alwayes to bee a whole yeare, moneth, day, or hower, nor the mouing of the celestiall bodies are to be measured alwaies by whole circles, signes, or whole degrées, & therefore to haue an exact measure of such things it was thought best by the auncient writers to diuide all whole things called Integra into the lessest parts that might bee, for which purpose no number was thought so méete as 60. for there is no number vnder 100. that receiueth so many Diuisions as 60. which may bee diuided many sundrie waies, that is by 2.3.4.5.6.10.12.15.20. and by 30. and therefore they diuide euery whole thing that had no vsuall parts into 60. minutes, and euery minute into 60. seconds, and euery second into 60. thirds, and so forth into 60. fourths, fifts, sixts, seuenths, eights, ninthes and tenths, and further if néede were, but that seldome chanceth. And you haue to note that minutes are marked with one stréke ouer the head, seconds with two strékes, thirds with three strékes, and so forth thus, ^{I}, ^{II}, ^{III}, ^{IV}, &c. which doe signifie 23. minutes 6. seconds 7 thirds, and 8. fourths.

Of Addition.

WHat is to bee obserued in adding of these kindes of Fractions?

First that you bring Integrums to Integrums, and Fracti-

ons

ons to Fractions, that bee of like denomination, beginning alwaies with the least on the right hand, and if the Summe of such Addition doe amount any where to the number of 60. or aboue 60. then you must looke how many 60. are comprehended therein, and for euery 60. adde one to the next greater Fraction that is on the left hand, obseruing still that order vntill you come to the Integrums, of which Integrums it is also necessary to know their value, that is to say, what parts they containe, and what denomination those parts haue: As for example, if you adde common signes such as the twelue signes of the Zodiaque bee, then euerie signe containeth 30. degrees, so as euery summe exceeding 30. is to be diuided by 30. but if they be Phisicall signes whereof 6. doe make a whole circle, such as be set downe in the table of Alphonsus, then the summe of those degrees is to be diuided by 6. Moreouer so often as the summe of the common signes doe exceede 12. or the summe of the Phisicall signes doe exceede 6. the ouerplus is alwaies to be reiected, and the remainder to bee set in the place of the signes, as you may see in this example following wherein seconds are reduced to minutes, minutes to degrees, and finally degrees to signes.

An example of Addition consisting of signes, degrees minutes and seconds.

Signes	Degrees	Minutes	Seconds.
9.	19.	1.	19.
0.	0.	35.	16.
11.	29.	33.	5.
9.	29.	38.	11.
0.	11.	49.	40.
		4.	56.
8.	0.	42.	27.

The totall Summe

In which example beginning first with the seconds because they are here the least Fractions, you shall find by Addition that the summe of them amounteth to 147. which being diuided by 60. you shall finde in the quotient 2. and the remainder to bee 27. which remainder you must set downe vnder the collum of seconds, keeping the quotient which is 2. in mind to be added to the collum of minutes, the summe whereof is 162. which being diuided by 60. you shall finde

in

in the quotient 2. degrées, and the remainder to be 4′2. which is to be set downe vnder the collum of minutes, and the quotient 2. kept in minde to bee added to the collum of degrées, the Summe whereof is 90. degrées, which being diuided by 30. (because that 30. degrées doe make one common whole signe) you shall find in the quotient 3. signes and no remainder: wherefore you must set downe a Cypher vnder the collum of degrées, and adde the 3. signes to the collum of signes, the summe whereof is 32. which if you diuide by twise 12. which maketh 24. you shall finde the remainder to be 8. signes, which is to be set downe vnder the collum of signes, for the quotient here is to bee reiected according to the rule before giuen, so as the totall summe of this Addition is 8. signes, 0. degrées 4′2. 2″.

Another example of daies, howers, minutes, and seconds to be added together.

In this example one self order as in the other before is to bee obserued as touching the secondes and minutes, for the exceeding number in both, are diuided by 60. but when you come to the howres you must diuide that number by 24. because that so many howers doe make a whole day, and hauing set downe the remainder vnder the collum of howers, adde that one day which was in the quotient, vnto the collum of daies, and so you shall finde the totall summe to be as the example aboue sheweth.

Daies	Howres	Minutes	Seconds.
21.	14.	32.	11.
16.	16.	19.	41.
8.	16.	30.	30.
46.	23.	22.	22.

Summa totalis

Of Subtraction.

WHat order is to be obserued in Subtraction?

The selfe same that was before obserued in Addition, so as you alwaies remember that when you haue to take a greater number of Fractions, as of minutes, seconds, thirds and such like, out of the lesser number of Fractions, to borrowe 60. and hauing set downe the remainder to adde the one borrowed, vnto the

next

next collum on the left hand, for there the 60. borrowed, is but one, but if you haue to deale with degrées, which are counted Integrums, then you must borrow but 30. for so many degrées doe make one signe, and if you haue to subtract howers, then you must borrow 24. for so many houres doe make one day, as by the example here following you shall more plainely perceiue.

Signes	Degrees	Minutes	Secondes
8.	0.	42.	27.
0.	1.	9.	53.
7.	29.	32.	34.

In this example because you can not take $''_{53}$. out of $''_{27}$. you must borrowe one minute from the next collum on the left hand, which one minute is $''_{60}$. which being added to 27. doe make in all $''_{87}$. out of which if you take $''_{53}$. there will remaine $''_{34}$. that done you must pay home the minute which you borrowed by adding the same vnto the next 9. on the left hand, which maketh 10. then say, take 1′0. out of 4′2. and there remaineth 3′2. which being set downe, procæde to the next. But here to take one out of none that cannot be, and therefore borrow one whole signe from the collum of signes which is 30. degrées from whence take one, and there remaineth 29. which being set downe, take the one which you borrowed out of 8. and there remaineth 7. so as the whole remainder of this Subtraction is 7/ signes, 29/ degrées, 3′2/ and $''_{34}$. as the former example sheweth.

Of Multiplication.

THough there be more difficultie in multiplying and diuiding Astronomical Fractions then in adding or subtracting them, yet the greatest difficultie thereof chiefly consisteth in the finding out of the true denomination of the products, for first as touching Multiplycation, you must multiply euery number of the multiplyer into all the particular numbers of the summe that is to be multiplyed, and then seuerally to adde together the products that bee of one selfe denomination, and whatsoeuer in that Addition ariseth to the number of 60. or excædeth 60. it is to be reduced by the sexaginarie Diuision into the greater summe, so shall you collect the whole

whole summe of the multiplication. But you haue to note by the way, that if there be any Integrums of diuers denominations in your multiplyer: That then such Integrums must be reduced to one selfe kinde of Integrums: As for example, suppose that you would multiply the dayly motion of the Moone which according to Alphonsus tables, is 13. degrees, 10.″11. and ‴/1. by 29. dayes, 12. houres, 44. and ″/1. here because there bee in this multiplyer Integrums of diuers denominations, that is to say dayes and howers, you must therefore reduce the same into one selfe denomination, before that you can make your Multiplication.

How is that to be done?

By multiplying euery number of the said multiplyer by 5. and then by halfing the product thereof, by which halfing you shall reduce minutes to seconds, and seconds to thirdes, and so forth to the smallest Fractions of all, and if any product doe amount to 60. or exceede 60. then you must diuide that product by 60. the remainder whereof is to be set vnder his proper denomination, and you must keepe the quotient in minde to adde the same to the next greater number as this example or table sheweth: In the front whereof I haue set downe in seueral spaces not onely the denominations of the two Integrums, as dayes and howers, but also the denominations of so many Fractions as I thinke meete to serue my turne, vnder which front I place the foresaid multiplyer, and then draw a line as you see in this example following.

Denomination.	Daies	Howers	′	″	‴	⁗
The multiplyer to be reduced into one selfe denomination.	29.	12.	44	3		
The products of the reductiõ.		29.	21	50	7	30

Now beginning first on the right hande with the least Fraction of the said multiplyer which is ″/1. I multiply 3. by 5. which maketh 15. the one halfe whereof is ‴/7. and halfe a thirde which is ⁗/10. wherefore I set downe the said ‴/7. and ⁗/30. vnder their proper denominations as you see in the example aboue, then I multiply 44 by 5. the product whereof is 220. and the halfe thereof is 110. which being diuided by 60. the quotient is ′/1. and the remainder ″/10. which remainder I set vnder his proper denomination, kee-

ping the quotient stil in mind, that doun, I multiply 12. howres by 5. the product whereof is 60. and the halfe of that is $3'0$. whereunto by adding the one which I had in minde, I make it $3'1$. and so I set it downe under his proper denomination, and because there be no more Fractions to be multiplyed, I set downe on the left hand the Integrum 29. and by this meanes I haue brought the foresaid multiplyer to one selfe denomination and to one kinde of integrum, that is to say to 29. dayes, $3'1.{}''_{30}.{}'''_{7}.{}''''_{30}$. which now being the greater number is to be set aboue, and to be multiplyed by the foresaid dayly motion of the Moone, that is 13. degrees, $1'0{}''_{35}$. and $'''_{1}$. but to the intent that in multiplying these numbers together you may set euery product in his true place, that is to say, under his proper denomination, it shal not be amisse in the front of your worke to set downe two rowes of numbers, whereof the first must containe so many denominations or Fractions as you thinke good, as minutes, seconds, thirds, fourthes, and so forth, marked with strokes and vulgare numbers, and the second rowe shall be the naturall order of numbers written in Arithmeticall figures as this table sheweth.

Integra	'	''	'''	''''	v	vi	vii	viii	The denominations.
0.	1.	2.	3.	4.	5.	6.	7.	8.	The naturall numbers.

Under which table you must first set the number that is to bee multiplyed, and right under that the Multiplyer in such sorte as euery particuler product may bee placed under his proper denomination, and then draw a line as you see in this example following, and when you haue multiplyed 2. numbers the one into the other, and know not where to place the product, then marke under which of the naturall numbers in the front, the said two numbers, that is to say the multiplier and the multiplicand doe stand: That done, adde those two naturall numbers of the front together, and the summe thereof will shew you under what denomination the product is to be placed, as in this example.

In

Int. gra.	I	II	III	IIII	V	VI	VII	Denominations. Naturall numbers.
0	1	2	3	4	5	6	7	
29	31	50	7	30				The Multiplicand.
13	10	35	1					The Multiplier.
			29	31	50	7	30	
		1015	1085	1750	245	1050		The seuerall products
	290	310	500	70	300			
377	403	650	91	390				The generall product or totall summe.
389	6	24	2	31	12	37	30	

In which example I first multiply $^{III}_{1}$. into $^{IIII}_{30}$. the product whereof is $^{VII}_{30}$. which must be set vnder the denomination VII. because the two naturall numbers that is 3. standing ouer 1. the multiplyer, and 4. standing ouer 30. the Multiplicand being added together doe make 7. appointing to the producte his proper denomination, then multiply againe the same $^{III}_{1}$. into $^{III}_{7}$ the product whereof is $^{VI}_{7}$ which must bee set vnder the denomination VI. because 3. standeth ouer both their heades, and therefore must be taken twice, that is to say for eth number 3. which being added together doe make 6. appointing thereby to the product his proper place of denomination, that done multiply the said $^{III}_{1}$ into $^{II}_{50}$. the product whereof is $^{II}_{50}$. which must be set vnder the denomination VI. for the 3. which standeth ouer 1. and the 2. ouer $^{II}_{50}$. being added together maketh 5. appointing to the product his proper place of denomination, then multiply the said $^{III}_{1}$ into 31. the product wherof is $^{III}_{31}$. here the two naturall numbers that is to say 3. standing ouer $^{III}_{1}$ & one ouer 31. being added together, do make 4. appointing to the product his proper place of denomination, then multiply the foresaid $^{III}_{1}$. into 29. Integrums, the product whereof is $^{III}_{29}$. and must be set vnder the denomination ^{III} because 3. standeth ouer $^{III}_{1}$ but 29. being an Integrum, hath no naturall number standing ouer him but a Cipher, thus hauing gone throughout all the numbers of the Multiplicand, with the first number of the Multiplyer proceede in like order with the second number of the Multiplyer which is $^{II}_{31}$. which being multiplyed into $^{III}_{30}$ maketh $^{VI}_{1050}$. to be set vnder the denomination VI. because 2. standeth ouer $^{II}_{31}$. the Multiplyer, and 4. ouer $^{III}_{30}$. the Multiplicand, which 4. and 2.

being added together maketh 6. then multiply $''_{35}$. by $'''_{7}$. which maketh $^{v}_{245}$. which you must set down vnder the denomination . because 2. and 3. maketh 5. that done, multiply $''_{35}$ by $''_{50}$. which maketh $''''_{1750}$. which you must set downe vnder the denomination $''''$ because the multiplycande and the multiplyer are both vnder the denomination $''$ which being twice repeated, maketh 4. then multiply $''_{35}$. by 3'1. and that maketh $'''_{1085}$. which you must set downe vnder the denomination $'''$ because 1. and 2. maketh 3. finally multiply 29. Integrums, by $''_{35}$. and that maketh $''_{1015}$. thus as you haue gone through with two numbers of your multiplyer, so procæde in like order with the other two numbers of the multiplyer which is 10. and 13. and when you haue ended your Multiplication, and set euery product in his proper place, and so as euery figure may stand one right vnder another, to auoide confusion when you come to Addition, (to which end the spaces of tollums had nèd to be the larger) then draw a line vnder all the products, and beginning on the right hand, adde all the products contained in euery seuerall collum together, and if the summe of any such particular Addition do arise to the summe of 60. or exceed the number of 60. then diuide that summe by 60. and set downe the remainder, kéeping the quotient in mind to be added to the product of the next collum on the left hand, so shal you find the total summe of your Multiplication to bé 389. degrees $6'.\ ''_{24}.\ '''_{2}.\ ''''_{31}.\ ^{v}_{12}.\ ^{vi}_{7}.$ and $^{vii}_{30}$. as the former example plainly sheweth. Now if you diuide 389. degrées by 30. because euery common signe containeth 30. degrées, you shall find your totall summe to be 12. signes, 29. degrées, $6'.\ ''_{24}.\ '''_{2}.\ ''''_{31}.\ ^{v}_{12}.\ ^{vi}_{37}.$ and $^{vii}_{30}$. and so much the Moone runneth in the space of 29 dayes, 12. howres, 4'4. and $''_{5}$. of an hower, which is her full reuolution betwixt euery two changes, but for as much as it chanceth as well in this example as in many others like, that Integrums of two sundry denominations are propounded in the question, it may very well be doubted with what denomination the product of such multiplication is to be named, as in this example hauing multiplyed time by motion, a man may aske whether the product shall be named daies or degrées, the resoluing of which doubt dependeth vpon the nature of the question propounded, for in the foresaid example, because time of dayes do comprehend any certaine appointed motion, therefore the product of the multiply-

cation

cation is to be referred to the degrées of motion which are comprehended vnder time, and not to time which comprehendeth motion, wherefore this product of Integrums videliz. 389. signifieth here degrées and not daies, so likewise when degrées and minutes are multiplyed by myles and minutes, the product of such Multiplycation taketh his name from myles and not from degrées, because degrées doe comprehend myles, for wee say in matters of Geography that euery degrée of the great Circle comprehendeth 60. myles, thus hauing spoken sufficiently of the Multiplycation of Astronomicall Fractions, we will now procéde to the Diuision of such Fractions.

Of the Diuision of Fractions Astronomicall.

WHat is to be obserued therein?

First you must consider whether your Diuisor be compound, or simple, I call that compound which containeth Fractions of diuers denominations, and that simple which consisteth of Integrums, or is one whole number of one selfe denomination, wherein there is no difficultie, for then you haue no more to do but to diuide euery particular number contained in the diuidend by ꝑ same Diuisor, and to place the product of euery one vnder such denomination, as the little table of denominations sheweth, & therefore it shall not bee amisse to set the foresaid little table ouer your diuidend euen as you did in Multiplycation: Also the Sexagenary progression is alwaies to be vsed, as well in Diuision as in Multiplycation. Moreouer if your Diuisor be not exactly contained in ꝑ diuidend, then hauing multiplyed the diuidend by 60. you must adde to the product therof the next Fraction following: As for example, knowing by Alphonsus tables that the daily motion of the Moone is 13. degrées, $1^{\circ}.\ 3^{\prime}.\ 5^{\prime\prime}.\ 10^{\prime\prime\prime}.\ 15^{\prime\prime\prime\prime}$. you would know how much she goeth in the space of an hower, here because that one day containeth 24. howers, the number must be 24. your Diuisor which is simple and not compound, first then set downe in the front of your worke the rowe of denominations onely, and not the naturall numbers because they are not to bee vsed in this way of Diuision, that done, right vnder the rowe of denominations place your diuidend, & right vnder that your Diuisor, as you sée in this example.

Degrees.	′	″	‴	⁗	⁵	The denominations.
14	10	35	1	15		The diuident.
24						The Diuisor.
	32	56	27	33	7	The seuerall summe of euery quotient.

In which example because the Diuisor 24. is not contained in 13. therfore I multiply 13 by 60. which maketh 780. whereunto by adding the next Fraction on the right hand which is $1'0$, the whole Summe is $79'0$. which being diuided by 24. the quotient is $3'2$. which because they are minutes, I place them vnder the denomination of minutes, and the remainder is $2'2$. which being multiplyed by 60. maketh $1''_{12}0$. whereunto I adde the next figure which is 35. and so the whole summe is $1\,1''_{15}$. which being diuided by 24. the quotient is $''_{56}$. which I place vnder the denomination of seconds, and the remainder of this Diuision is $''_{11}$. which being multiplyed by 60. maketh $'''_{660}$. whereto I adde the next Fraction which is $'''_{1}$. so that now the whole summe is $'''_{661}$. which being diuided by 24. the quotient is $'''_{27}$. which I set downe vnder the denomination of thirds, and the remainder is $'''_{13}$. which being multiplyed by 60. maketh $''''_{780}$. whereunto I adde the next Fraction which is $''''_{15}$. which maketh in all $''''_{795}$. which being diuided by 24. the quotient is $''''_{33}$. which I place vnder the denomination of fourths and the remainder is $''''_{3}$. which being multiplyed by 60. maketh $^{v}_{180}$. whereunto hauing no Fraction to adde, I diuide the same by 24. and so I find in the quotient $^{v}_{7}$. which I set vnder the denomination of fifts, so as I find the howerly motion of the Moone to be $3'2.\,''_{56}.\,'''_{27}.\,''''_{33}.\,^{v}_{7}$. and somewhat more, for I leaue to deale any further with the smaller fractions that would still grow by multiplying the remainders by 60. thinking this sufficient to shew you in what order you haue to worke, to diuide your dividend by a simple Diuisor, into as many small parts as you will: but if your Diuisor be compound, then the diuision is to be done either by reduction into the smallest Fractions, or without reduction: which last way is very hard and tedious, and therefore I will onely shew you how to make your diuision whereof the Diuisor is compound by reduction, and that by this one example here following. Suppose then that the Moone according to her owne course which is from West to East, is distant from some fixed Starre 36. degrees, $3'0.\,''_{24}.\,'''_{30}$. and $''''_{15}$. and that you would know in what time she will runne

that

that distaunce, according to her daily moving which as hath bene said before is 13. degrees, 1′0. $_{1}^{''}$. $_{2}^{'''}$. and $_{15}^{''''}$. here to make this diuision by reduction, you must doe thus. First reduce all the numbers of your diuidend into the smallest Fractions thereof by the Sexagenarie Multiplycation and Addition of the next Fraction vnto the product of that Multiplycation: that done, reduce all the numbers of your Diuisor by like Multiplycation and Addition, into the smallest Fractions, so as the diuidend & the Diuisor may be both of one selfe denomination, and diuide the one by the other, euen as they were Integrums, as in this example you must first multiply 36. degrees, by 60. and it will make 2160. whereto by adding 3′0. you make the whole summe of minutes to bee 2190. which being multiplyed againe by 60. doe make $_{1}^{''}$. whereto if you adde the $_{24}^{''}$. the summe of secondes will bee $_{1}^{''}$$_{424}$. and so proceeding still with the Sexagenarie Multiplycation and Addition of the next Fraction as you did before, you shall find the diuidend to be $_{47}^{'''}$$_{12}^{''''}$$_{94}^{'''''}$$_{51}^{''''''}$. Then in like order reduce your Diuisor into the smallest Fraction, and you shall find the totall summe thereof to be $_{170766075}^{'''}$. this reduction being made, diuide the diuidend by the diuisor, so shall you finde in the quotient two Integrums, that is to say 2 daies, and the remainder to be $_{132597365}^{'''}$. which remainder if you multiply by 60. and diuide the product by the selfe same Diuisor, you shall haue in the quotien minutes, then multiply againe that remainder by 60. and diuide the product thereof by the same Diuisor, and you shall haue in the quotient seconds, and so by obseruing still that order you shall bring it into as small Fractions as you will, thus shall you finde that the Moone according to her daily motion, will runne the foresaide space of distance that was betwixt her and the fixed Starre in two daies, 4′6. and 1″4.

Howe to diuide Astronomicall *Fractions when the Diuisor* is greater then the diuidend.

Cap. 28.

THough by the last chapter you may learne how to diuide any number in Astronomicall Fractions, whereof the Diuisor is greater then the diuidend, yet I minde once againe, to set downe a generall rule to serue for such purpose, because it commeth often in vse in hauing to deale with Astronomical tables, and to giue you example thereof: First then hauing to diuide any number, whose Diuisor is greater then the diuidend, doe thus: multiply the greatest denomination of the diuidend by 60. and if there be any Fractions annexed thereunto which are of the next inferiour kinde, as minutes are to degrées, or to howers, and seconds to minutes, and thirds to seconds &c. Then adde them to the former product, but if such Fractions be not of the next inferior kind, then let them stand as they are vntill you come to deale with them, and hauing diuided according to the common rule of Diuision the first summe of the diuidend by the Diuisor, multiply the quotient into the whole Diuisor, and subtract that product out of the vpper number if it may bee, if not, then take the quotient lesser and lesser, vntill you can finde such a number as will be subtracted out of the said vpper number, and if there be any remainder left, then multiply that remainder by 60. not leauing to follow the former order of working, vntill you haue found the neerest exact quotient that may be. And you haue to note that the denomination of the first quotient must be of ỳ next inferior kind, to that denomination which the Diuisor hath, and to make this rule the plainer, I will set downe an example vsed by Stadius in the 115 Page of his Ephemerides who to know the very instant of the full Moone the second of March 1569. biddeth to diuide the distance of the opposition which was 8. degrées, 4'6. by the diurnal excesse of the Moones

motion

motion from the Sunne which was then 13. degrées 4′8. which Diuisor because it is greater then the dividend, you must according to the rule before giuen, worke thus: First multiply the greatest denomination of the dividend which is 8. degrées by 60. the product whereof will be 480. whereunto by adding the Fraction annexed videliz. 4′6. it maketh in all 52′6. which is to be diuided by 13. degrées, 4′8. here in diuiding the last product first by 13. degrées, I finde in the quotient 39. which is one too many, considering that I must take out of the foresaid dividend 4′8. as often as I did take out thereof 13. degrées, wherefore I set downe but 38. in the quotient, and then the remainder will be 96. which because I may easily diuide by the common Diuisor 13. degrées, and 4′8. I diuide therefore that 96. first by 13. whereof the quotient is 7. and the remainder is 5. which I reduce into seconds by multiplying that 5. by 60. the product whereof is 300″. that done, I multiply 4′8. by 7. the product whereof is 336. which though it bee somewhat too great a number to bee taken out of 300. yet I let it stand because it approcheth to a very nigh exactnesse, and by this meanes I finde the whole quotient to bee 38′. and 7″. and you haue to note that if after the first quotient be set downe, there happen any remainder which is lesser then the Diuisor, then you must set down a Cypher in the quotient, and remoue your Diuisor one place further, euen as you doe in common Diuision, and then to worke as before.

How to take the square Roote of *Astronomicall Fraction.*

Cap. 29.

The greatest difficultie hereof consisteth in finding out the true denomination of the roote, for if the Fraction be seconds, then the roote hereof are minutes, and if the Fraction bee fourths, then the roote are seconds, for the Fraction must alwayes haue such denomination as may bee halfed, seconds, fourths, and such like, the one halfe whereof giueth alwaies

name

name to the roote, for if the question be of thirds, you must first reduce them to fourths before you can take the roote, and you must doe the like with any other Fractions, whose denomination is odd and not euen. As for example, if you would take the Roote of $'''_{41}$. here by multiplying these $'''_{43}$. by 60. you shall reduce them into $_{2,5}'''_{00}$. the roote whereof is $''_{50}$. Moreouer the Fractions wherewith you haue to deale, are either simple, or compound, if they be simple and lesse then minutes, and therewith haue euen denominations and not odde, then you need to make no further reduction, but to worke as if you had to deale with whole numbers. As in seeking the square roote of $_{1,60}''$. you finde it to be iust $4'0$. but if the number be compounded, that is to say, consisting of integrums and Fractions, or of many Fractions hauing diuers denominations, then you must first reduce them all to the smallest Fraction that hath an euen denomination before that you can take the roote: As for example, you would know the roote of 4. degrees, $2'5$. here you must by the Seragenarie Multiplycation and Addition of the next Fraction, reduce the degrees to minutes, and the minutes to seconds, as you were taught before in Diuision, and then to worke as you were wont to doe in taking the square roote of whole numbers, and in so doing, you shall finde the summe of seconds to be $_{1,9}''_{00}$. the square roote whereof is $12'6$. which if you diuide by 60. it will make 2. degrees, $6'$. Another example, as to take the roote of 13. degrees, $4'2$. and $''_{45}$. here by reduction as before, you shall bring the degrees and minutes to $49.36''5$. the square roote whereof is $22'2$. which being diuided by 60. maketh 3. degrees, $4'2$. And thus I ende with the Astronomicall Fractions, which kinde of Fractions, though they bee very learnedly and orderly taught by Reinoldus in the beginning of his Pruteni call tables, yet in mine opinion not in so plain order, and so fit for euery mans vnderstanding, as I haue here set them downe according to the doctrine of Gemma Frisius, which being once learned, you shall the soner attaine to the other. And without the knowledge of these Fractions, you can neuer truely calculate any thing out of the Astronomicall tables, and therefore such Fractions are most necessarie to be learned.

Notwithstanding the better to Calculate by the said Pruteni-

call

call Tables or by any other Astronomicall Tables, I must set downe here one thing more, which I had cleane forgotten in my first Edition, that is to declare vnto you, that in those Tables are often vsed two kinds of denominations, whereof the one is called Sexagenæ and the other Sexagesimæ, and that the denomination Sexagenæ being set ouer any number doth signifie that the vnite of the Integrum is multiplyed by 60. But the denomination Sexagesimæ doth signifie that the vnite of the Integrum is diuided by 60. and you haue to note that Sexagenæ haue the like partes or denominations that Sexagesimæ haue as Prims, ″ . ‴ . ⁗ . and so forth differing onely in placing the saide denominations, for the denominations of the Sexagenæ are alwaies set on the left hande of their Integrums, but the denominations of the Sexagesimæ are set on the right hand of their Integrums. And to ease you of your paine as well in multiplying & in diuiding as also in taking the square Roote of Astronomicall Fractions, I haue though good to set downe this Table heere following called the Sexagenarie Table together with the discription and vse thereof which Table is also set downe in my first Edition.

The

The deſcription and vſe of the *Sexagenarie Table.*

THis table conſiſteth of two figures, whereof the neather figure hauing fower Angles, is called in Latine Trapezium, marked with the letters A. D. E. B. and the vpper figure is a Triangle, marked with the letters A. B. C. and each figure containeth particular collums of numbers, ſeruing to finde out the products of Aſtronomicall Fractions being multiplyed one by another, and alſo the quotients of the like Fractions being diuided one by another, and alſo the ſquare rootes of the ſaid Fractions, for which purpoſe the firſt collum on the left hand, containeth 59. Fractions, counting from 1. ſtanding aboue, and ſo proceeding down-ward to 59. and are contained betwixt A. and D. and the foote of the ſaid Trapezium, containeth 30. counting from the left hand towardes the right, which are contained betwixt D. and E. and the reſt of the numbers to make vp 59. are to bee found in the vpper moſt front of the Triangle, proceeding from C. towards A. you haue to note alſo that in the outermoſt collum of the Trapezium on the right hand, the numbers doe proceede downeward from 30. to 59. that is from B. to E. and the numbers in the outermoſt collum of the Triangle on the right hand, doe proceede vpward from 31. to 59. contained betwixt B. and C. both which doe ſerue to fill vp the firſt multiplyers, and multiplycands, for when you cannot finde them in the Trapezium, then the outermoſt collum of the Triangle on the right hand, ſeruing to ſupply that want, and when you cannot finde the ſaid numbers in the Triangle, then the outermoſt collum of the Trapezium on the right hand, ſerueth to ſupplie that want, and in ſeeking any multiplyer or multiplycand, either

eyther in the Trapezium or in the Triangle, consider alwayes which way they are most readily found out, so as they may directly aunswere one against another.

All the rest of the numbers contained betwixt the two outermost collums and are set downe in square Angles, called common Angles do signifie eyther Products or diuidends or square numbers according as occasion shall require. And the outermost collums do signifie sometime multiplyers, sometime multiplicands, sometime quotients, and sometime rootes. All which things you shall better vnder stande by the examples hereafter following.

The vse of the Table.

BY helpe of this table you may more readily multiply & diuide Astronomicall Fractions, and also finde out the square root of such Fractions, then by those rules which I haue heretofore set downe according to the doctrine of Gemma Frisius. And first I will set downe an example of Multiplication, then another of Diuision, and thirdely one example of finding out the square roote of the said Fractions, and let the example of multiplication be thus: Suppose that you would multiply 29. degrees, $3'\ 1.\ {}''_{53}.\ {}'''_{7}.\ {}''''_{30}.$ by 13. degrees, $1'\ 0.\ {}''_{5}.\ {}'''_{1}.$ which you must set downe in such order as followeth, (that is to say) first the denominations, then next vnder them the multiplicand, and next vnder that the multiplyer, and vnder them the seuerall products, and lowest of all the total summe of the said products.

Integra	De.	′	″	‴	⁗	V	vi	vii	Denominations
	29	31	50	7	30				The Multiplycand.
	13	10	35	1					The Multiplyer.
				29	31	50	7	30	The first product.
		17	13	34	14	22	30		The seconde product.
	4	55	18	21	15	0			The thirde product.
6	23	53	51	37	39				The fourth product.
6	29	6	24	2	31	12	37	30	The totall summe.

Here beginning with the first number of the multiplyer on the right hande which is ″, say thus, one times 30 is 30 which is to be placed vnder the denomination of 7. because the denomination ouer 1. is 3. and the denomination ouer 30. is 4. which being added togither according to the rule before sette

downe

downe in the Chapter of Multiplycation of Astronomicall Fractions do make 7. then say one times 7. is 7. which you must place vnder the first denomination. Againe, one times 50. is 50. which is to bee set vnder the fift denomination, because 3. and 2. maketh 5. then say one tymes 31. is 31. which is to bee set vnder the fourth denomination, for 3. and 1. maketh 4. then one times 29. is 29. which is to bee set vnder the third denomination, and thus you haue the first product, then proceede with the next number of the multiplyer towards your left hand which is 35 and is to be multiplyed into 30. which to doe readily, you must enter the table with these two numbers, and seeking in the first Collum of the Trapezium on the left hand, for 35. in the foote of the saide Trapezium, for the number of 30. you shall finde in the common angle the product to bee 17. and 30. whereof you must place the 30. vnder the first denomination, and keeping the number 17. still in minde to be added to the nert product, multiply 35. into 7. and you shall finde in the Trapezium the product to bee 4. and 5. whereunto if you adde the 17. which you had in minde, the product will be 4. and 22. whereof you must set the 22. vnder the fift denomination, and keeping the 4. in minde, multiply agayne the same 35. into 50. the product whereof you shall finde in the Triangle to be 29. and 10. whereto if you adde the 4. in minde, it will make 29. and 14. whereof the 14. is to be placed vnder the fourth denomination, and keeping the 29. in minde, multiply againe the said 35. into 31. and you shall finde the product thereof in the Triangle to bee 18. and 5. whereunto if you adde 29. in minde, it will make in all 18. and 34. which 34. is to be set vnder the third denomination, then keeping 18. in minde, multiply the foresaid 35 into 29. and you shall finde the product thereof in the Trapezium to be 16. and 55. whereunto if you adde the 18. in mind, the product will be 17. and 13. which 13. is to be placed vnder the second denomination. Now because you haue gon through all the numbers of the multiplicande with the number 35. you must place the 17. which you had in mind vnder the denomination of minutes, and so hauing ended the second product, proceede to the finding out of the third product by multiplying 10. first into 30. the product whereof you shall finde in the Trapezium to bee 5. and 0. whereof you must set the Cipher vnder the fift denomination

nation

nation, and kæping the 5. in mind multiply againe 10. into 7. and you shall find the product to be 1. and 10. whereunto if you adde the 5. in mind, the product will be 1. and 15. whereof you must set the 15. vnder the fourth denomination, and kæping the one in minde, multiply 10. into 50. and you shal find the product thereof in the Trapezium to be 8. and 20. whereunto if you adde the 1. in mind, it will make 8. and 21. whereof you must set the 21. vnder the thirde denomination, and kæping 8. in mind, multiply 10. into 31. and you shall find the product thereof in the Trapezium to be 5. and 10. vnto which if you adde the 8. in minde, the product will be 5. and 18. whereof set downe the 18. vnder the second denomination, and kæping 5. in minde multiply. 10 into 29. the product whereof you shall finde in the Trapezium to bee 4. and 50. whereunto if you adde the 5. in mind, the product wil be 4. and 55. Now because you haue gone through all the numbers of the Multiplicand, with 10. you must set downe the 4. which you had in minde vnder the denomination of degrees, and so hauing the third product, procæde to the fourth by multiplying 13. into 30. and you shall find the product in the Trapezium to be 6. and 30. whereof set downe 30. vnder the fourth denomination of Fractions, and kæping 6. in mind multiply 13. into 7. the product whereof you shall finde in the Trapezium to bee 1. and 31. whereunto if you adde the 6. in minde, the product will bee 1. and 37. whereof set downe the 37. vnder the third denomination, and kæping the 1. in mind multiply 13. into 50. and you shall find the product in the Trapezium to bee 10. and 50. whereunto if you adde the one in mind, the product will be 10. and 51. whereof set the 51. vnder the second denomination of Fractions, and kæping 10. in minde multiply 13. into 31. the product whereof you shal finde in the Trapezium to bee 6. and 43. whereunto if you adde the 10. in mind, the product will be 6. and 53. whereof set downe 53. vnder the first denomination of Fractions, and kæping 6. in mind multiply 13. into 29. the product whereof you shall finde in the Trapezium to be 6. and 17. whereunto if you adde ỹ 6. in mind, the product will be 6. and 23. whereof set downe 23. vnder the denomination of degrees. Now because you haue gone through all the numbers of the multiplicand with the last number of the multiplier, you must set downe the 6. which you had in minde vnder

the

the denomination of Integrums, that doon, adde all the foure products together, beginning on the right hand, saying thus, 30. 30. is but 30. which set downe vnder the nethermost line, as you see in the former figure, then say 30. and 7. maketh 37. which you must set downe vnder the nethermost line next vnto 30. then say 22. and 50. maketh 72. out of which by subtracting the Sexagenarie number, the remainder is $\frac{v}{12}$. which is to bee set vnder the line next vnto the 37. keeping still the 60. in minde, which in this account maketh but one, and is to bee added to the next ranke on the left hand, then say 1. in mind and 5. maketh 6. and 4. maketh 10. and 1. maketh 11. here set downe 1. and keepe the Article in minde, then say 1. in mind and 3. maketh 4. then 1. and 1. and 3. being added to 4. doe make in all 9. out of which 9. you must subtract 6. which is but one 60. and is to bee kept in minde and there remayneth 3. which is to be set downe by the 1. then say 1. in mind and 7. is 8. and 2. is 9. and 4. is 13. and 9. is 22. here set downe 2. and keepe the 2. Articles in minde, then say 2. and 3. maketh 5. and 2. is 7. and 3. is 10. and 2. maketh 12. tennes, which doe make 2. sixties, and are to bee kept in minde, then say 2. and 1. maketh 3, and 8. maketh 11. and 3. maketh 14. wherefore set down 4. keeping the 1. Article in minde, then say 1. in mind and 5. is 6. and 1. is 7. and 1. is 8. then take 6. from 8, and there remayneth 2. which set downe by the 4. and keepe one sixtie in mind, then say 1. in minde and 3. is 4. and 5. is 9. and 7. is 16. wherefore set downe 6. and keeping one in mind, say that 1. and 5. is 6. and 5. is 11. and 1. is 12. which maketh two sixties to bee kept in minde, then say 2. in minde and 3. is 5. and 4. maketh 9. which set downe, then say 2. is 2. which set downe by the 9. vnder the denomination of degrees, then say 6. and nothing maketh 6. which set downe vnder the denominations of Integrums, for that 6. in this place signifieth 6. sixties, which is in value 360. degrees, and being diuided by 30. because 30. degrees maketh one whole signe, you shall finde in the quotient 12. signes, so as the totall summe of the foure productes is 12. signes, 29. degrees, 6'. ii. 24. iii. 1. iiii. 31. v. 12. vi 17. vii 30. as the former figure sheweth, and this is the very same example which I wrought before when I taught you howe to multiply Astronomicall Fractions according to Gemma Frisius his rule, and they both doe wholly agree in euery condition, sauing that to

worke by the Sexagenarie Table is the readier way of the two.

An example how to diuide Aſtronomicall Fractions by helpe of the Sexagenarie Table.

SVppoſe then that you would diuide the former totall ſumme or product found by Multiplycation, which is 6. Integrums, 29. degrées, $6'.{}^{''}24.{}^{'''}2.{}^{''''}31.{}^{v}12.{}^{vi}37.{}^{vii}30.$ by this Diuiſor 29. degrées, $3'.{}^{''}50.{}^{'''}7.{}^{''''}30.$ which in the former example of Multiplycation was the multiplycand. Now to diuide theſe two numbers the one by the other, you muſt doe thus, firſt you muſt ſet downe the rowe of denominations as you did before in Multiplycation, and next vnder that the diuidend, then right vnder that the Diuiſor, and on the right hand behind a crooked line made like a halfe Moone, all the ſeuerall quotients are to bee ſet one by another in a right line, as you may ſée by the figures hereafter following.

Heere hauing made your rowe of denominations, and ſet downe your diuidend, you haue to conſider whether the firſt number of your Diuiſor be greater then the firſt number of your diuidend, for if it be, then you muſt place your Diuiſor one ſpace further towardes your right hand, as in this example, becauſe the firſt number of your Diuiſor 29. cannot be taken out of 6. you ſet it vnder the ſecond number of the diuidend, and ſo all the reſt of the numbers ſucceſſiuely towardes the right hand, as the former example ſheweth. Now the order of working is thus: You muſt firſt ſéeke out the firſt number of your Diuiſor, in the firſt collum of the Trapezium on the left hand which is 29. then in the rowe right againſt that 29. on the right hand, you haue toſéek out thoſe numbers of the diuidend, which do ſtand right ouer the firſt number of your Diuiſor which is 6. and 29. and if you cannot finde thoſe numbers iuſtly, then ſéeke in the ſelfe ſame rowe a number which is ſomewhat leſſe and neareſt in value vnto it, as in this example, becauſe you cannot finde 6. and 29. you take 6. and 17. the quotient, whereof you ſhall find in the foote of the Trapezium right vnder the ſaid number 6. and 17. to bee

Integrum	dc.	′	″	‴	⁗	v	vi	vii
Denomination								
6	29	6	24	2	31	12	37	30
The diuidend.								
	29	31	50	7	30			
The Diuiſor.								

13. degrées, which you must set in the quotient line, and that is your first quotient, hauing his proper denomination ouer his head which are degrées, and are to bee found by the rule before taught. Thus you see here that the number of the Diuisor is to bee found in the outermost collum on the left hand, and the number of the diuidend in that rowe which is right against the said Diuisor, and the quotient in the foote of the Trapezium right vnder the number of the diuidend last found. Then you haue to multiply the whole Diuisor (that is to say) euery particular number thereof by the first quotient 13. which you may doe by helpe of the Table, as you did before in the example of Multiplycation, and is to be set downe in this manner. And you shall finde the whole product to be 6.23.53.51. 37.30.

29.31.50.7.30
13

Which being set right vnder the first diuidend, is to be subtracted out of the same, and the remainder to be witten ouer the head of the diuidend as you doe in common Diuision, first then to multiply all the particular numbers of the Diuisor by the quotient 13. and to find euery product thereof, resort to the Table and seeke for 13. in the foote of the Trapezium, and for 30. which is the multiplycand in the outermost collum of the Trapezium on the left hand, and the common angle will shew the product which is 6. and 30. whereof you must set downe 30. vnder 30. and keeping 6. in mind, multiply againe 13. into 7. the product whereof you shall finde to bee 1. and 31. vnto which adde the 6. which you kept in mind, and the product shall be 1. and 37. whereof you must set downe 37. and keeping one in mind, multiply againe 13. into 50. and you shall find the product to be 10. and 50. whereunto if you adde 1. in minde, the product shall be 10. and 51. whereof you must set downe 51. and keeping 10. in mind, multiply 13. into 31. the product whereof you shall find in the Trapezium to be 6. and 43. whereunto if you adde the 10. which you had in mind, the product shall be 6. and 53. whereof set downe 53. and keeping 6. in mind, multiply 13. into 29. and you shall find the product to be 6. and 17. whereunto if you adde the 6. in mind, the product shall be 6. & 23. whereof set downe 23 vnder

	29	31	50	7	30	The Diuisor.
					13	The first quotient.
6	23	53	51	37	30	The first product.

vnder the last number of your multiplycand, and because you haue no more numbers of the Diuisor to be multiplyed, set downe 6. in mind on the left hand, so shall the whole product bee 6.23.53.51. 37.30. as the former example sheweth, which product is to be subtracted out of the first deuidend, & the remainder is to be set downe ouer the head of that diuidend, as you see in this example next following, wherein the first diuidend is first set downe, and right vnder that the foresaid product which is the first product, and the remainder aboue the diuidend, and the quotient 13. is set in the quotient line which is your first quotient.

The remainder		5	12	32	25	1			
The first diuidend.	6	23	6	24	2	31	12	37	30
The first product	6	23	53	51	37	30			

(13.

And remember (in making your Subtraction) to begin with the first number of the foresaide product which is on the right hand, and when you cannot take it out of the number standing right ouer his head, to borrow alwaies 60. of the next number on the left hand, and to pay it home againe with 1. for there 60. is but one. This done, remoue your Diuisor one space further towardes the right hand (that is to say) set the first number of your Diuisor vnder 12. which is the second number of the second diuidend, which together with the first remainder is 5.12.32.25.1.12.37.30. and all other numbers of the Diuisor orderly towards your right hand, as you see in this example.

The second diuidend.	5	12	32	25	1	12	37	3
The diuisor		29	31	50	7	30		

Then aske how many times 29. is in 5. & 12. which number you must seeke in the Trapezium in the rowe that answereth towards the right hand, to the first number of your Diuisor which is 29. standing in the outermost collum of the Trapezium on the left hand, and because you cannot find 5. and 12. in that rowe, you must take in the same rowe the number which is nigheſt vnto it, but lesse, which you shall find to be 4. and 50. and right vnder that in the foote of the Trapezium you shall find 10. which must be your second quotient, by which quotient you haue to multiply all the particular numbers of the Diuisor in such order as is before set

downe and you shall find the product of that Multiplycation to be 4.55.18.21.15.0. which product you must place vnder the second diuidend setting 4. vnder 5. and 55. vnder 12. and so forth orderly towards the right hand, that done, subtract the same product out of the numbers of the second diuidend, standing right ouer the said product, and the remainder will be 17.14.3.46.12. as you see in this example.

The remainder.	17	14	3	46	12	37	30	
The second diuidend.	5	12	32	25	1	12	37	30
The second product.	4	55	18	25	15	0		

(13.10.

Now remoue your Diuisor one space further towardes the right hand by setting the first number of your Diuisor which is 29 vnder 14. which is the second number of the third diuidend, and so all the rest orderly towardes the right hand, as you see in this example.

The third diuidend.	17	14	3	46	12	37	30
The Diuisor.		29	31	50	7	30	

Then aske how many time 29. is contained in 17. and 14. which diuidend because you can not find it in the rowe that answereth to that 29. which standeth in the outermost collum of the Trapezium on the left hand (for all those numbers are too little) you must seke for it in that collum which standeth right vpon 29. in the foote of the Trapezium, neither shall you find it there, but you shall finde 16. and 55. which is somewhat lesser yet in value nigheſt vnto 17 and 14. and right against that you shall finde in the outermost collum on the right hand 35. which must be your third quotient to be set in the quotient line, whereby you haue againe to multiply the whole Diuisor in such order as before, the product whereof you shall find to be 17.13.34.14.22.30. which product being placed vnder the diuidend by setting 17. vnder 17. and 13. vnder 14 and so forth orderly towards the right hand, subtract the said product (beginning at the right hand) out of the numbers which stand right ouer the said product, and the remainder will be 29.31.50 7.30. which is to be set downe ouer the third diuidend, and the rest to be cancelled as you see in this example.

The

The remainder				29	31	50	7	30
The third diuidend.	X7	X4	3	46	X2	37	30	(13.10.35.
The 3. product	17	X2	24	X4	22	30		

And now the remainder of the third diuidend is come to be the fourth diuidend, wherefore remoue your Diuisor one space further towards the right hand by setting 29. vnder 29. and the rest orderly towards the right hand as you see in the example following. Then aske how many times 29. is contained in 29. which being but once, your fourth quotient is 1. and is to bee set in the quotient line, whereby the whole Diuisor being multiplyed, the product will be 29.31.50.7.30. which you must place vnder the fourth diuidend, & being subtracted out of the same, nothing will remaine, and so the whole quotient will be 13. degrees, $1'0.3''5.1'''$. as you see in this example.

The fourth diuidend.	0	0	0	0	0		degr.	′	″	‴
The fourth product.	29	3X	50	7	30		(13.	10.	35.	1.
	29	3X	50	7	30					

Another example of Diuision,

IF the dayly motion of the Moone be 13. degrees $3'.''.'''.''''.'''''.$ in what time shal she make her whole reuolution allowing 360 degrees to that reuolution, which is otherwise called the moneth of Paragration. Heere for so much as this example is to bee wrought by Diuision, and that your diuidend is a simple & whole number (that is to say) 360. degrees, without any Fractions of diuers denominations annexed thereunto: you must first set down the 360. degrees, and next to that towardes your right hand set downe a long row of Cyphers with so many denominations ouer their heads as you shall thinke needful to serue your turne, & right vnder your diuidend set your Diuisor as you see in this example.

Integrum	De.	′	″	‴	⁗	V	VI	VII	VIII	IX	
The denominations.											
The diuidend	360	0	0	0	0	0	0	0	0	0	(27
The Diuisor.	13	3	53	56	23	58					
The 1. product	352	45	16	22	47	6					

Here you must first aske how may times 13. is in 360. and by the common rule of Diuision you shall find the quotient to bee 27. which you must set down in the quotient line, and by that quotient you haue to multiply euery particular number of the Diuisor beginning on the right hand, as you doe in Multiplycation, saying that 27. times 58. is 26. and 6. as the Trapezium sheweth, for by séeking 27. in the foote of the Trapezium and for 58. in the outermost collum on the right hand, you shal find in ỹ common Angle 26. and 6. wherefore set downe 6. vnder 58. and kéeping 26. in mind, multiply 23. which is the second number of the Diuisor by 27. and by the Trapezium you shall find the product thereof to be 10. and 21. whereunto if you adde the 26. in mind, it will make 10. and 47. whereof set downe 47. vnder 23. and kéeping 10. in mind, multiply 56. which is the third number of the Diuisor by 27. and in the Trapezium you shall finde the product to bee 25. and 12. whereto if you adde the 10. in minde, it will make 25. and 22. whereof set downe 22. vnder 56. and kéeping 25. in mind, multiply 53. which is the fourth number of the Diuisor by 27. the product whereof you shall find by the Trapezium to be 23. and 51. whereto if you adde 25. in mind, it will make 76 which is one 60. and 16. whereof set downe 16 vnder 53. and adde the one in mind to 23. and that will make 24. which you must kéepe in mind, then multiply 3. which is the fift number of the Diuisor by 27. the product whereof you shall find in the Trapezium to be 1. and 21. whereto if you adde the 24. in mind, it will make 1. and 45. whereof set downe 45. vnder 3. and kéeping 1. in mind, multiply 13. which is the last number of the Diuisor by 27. the product whereof you shall find in the Trapezium to be 5. and 51. whereunto if you adde one in mind, it will make 5. and 52. here because the first 5. is 5. sixties, it maketh in all 352. and is to be set vnder 360 so as the first product of this Multiplycation containeth these numbers 352. 45. 16. 22. 47. 6. as you sée them set downe in the former example, and this product is to be subtracted out of 360. which is the first diuidend. And to auoide confusion, it shall not be amisse to set downe the first Diuidend and the first product apart by themselues thus.

The

The first remainder.	7	14	43	37	12	54	0	0	0	
The first diuidend	360	0	0	0	0	0	0	0	0	(27.
The first product	352	45	10	22	47	6				

Heere beginning on the right hand say thus, take 6. out of nothing which will not bee, wherefore you must borrow 60. then by taking 6. out of 60. there will remaine 54. which you must set aboue that Cypher which standeth right ouer 6. and cancell the 6. keping stil the one 60. which you borrowed in mind, then say 47. & one in mind maketh 48. which wil not be taken out of nothing, and therefore you must borrow againe one 60. as you did before, so shall the remainder bee 12. which is to bee set aboue the Cypher which standeth right ouer 47. and cancell 47. and so proceede with like order in subtracting al the rest of the numbers of the first product out of the first diuidend, so shall the remainder be 7. 14. 43. 37. 12. 54. as you see them set downe in the former figure. Now hauing to remooue your Diuisor one space further towardes the right hand, you shall doe well to make your first remainder which is 7. 14. 43. 37. 12. 54. to be your second diuidend, and vnder that to set your Diuisor as you see in this example.

The second diuidend	7	14	43	37	12	54	0	0	0	(27. 33.
The diuisor.		13	3	53	56	23	58			

Then aske how many times 13. is contained in 7. and 14. and hauing found 13. in the foote of ỳ Trapezium, seek in that collum for 7. and 14. and not finding it there, take in the self same collum that number which is nigheſt in valu vnto it & lesse, which you shal find to be 7. and 9. right against which in the outermost collum on the right hand is 33. which must be your second quotient, and is to be set in the quotient line, next vnto 27. and by this quotient you haue to multiply euery number of the Diuisor as you did before, the product wherof you shal find to be 7. 11. 8. 40. 1. 10. 54. wherfore you must first set down your second diuidend, and then the second product right vnder the same as you see in this example.

The second remainder.		3	34	57	11	43	6			
The second diuidend.	7	14	43	37	12	54	0	0	0	(27. 33.
The second product.	7	11	8	40	1	10	54			

Which product being subtracted out of the second diuidend, the remainder will be 3. 34. 57. 11. 43. 6. which is to be set aboue the second diuidend, and the product to be cancelled as you see in the former example. Here hauing to remoue againe your cõmon Diuisor one space further towards the right hand, set down first the last remainder which now must bee your third deuidend, and vnder that set the common Diuisor as you see in this example.

The third diuidend.	3	34	57	11	43	6	0	0	0
The Diuisor.		13	3	53	56	2	58		

(27. 33. 16.

Then aske howe many times 13. is contained in 3. and 34. here by seeking in the foote of the Trapezium for 13. though you cannot find in that collum 3. and 34. yet you shall find 3. and 28. which is the nigheſt, right against which in the outermost collum on the left hand, you shall find 16. which must be your third quotient, and is to bee set in the quotient line, by which quotient you must multiply the whole Diuisor as before, the product whereof you shall find to be 3. 29. 2. 23. 2, 23. 28. which being the thirde product you must set downe vnder the third diuidend which was your last remainder and to bee subtracted out of the same as you see in this example.

The third diuidend.		5	54	48	40	42	32	0	0
	3	34	57	XX	43	6	Ø	Ø	Ø
The third product	3	20	2	23	2	23	28		

And so the remainder will be 5. 54. 48. 40. 42. 32. which you must set aboue the third diuidend, and al the inferior numbers are to be cancelled as you see in the former example. Heere hauing againe to remoue your Diuisor one space further towardes your right hand, the last remainder must be your fourth diuidend, vnder which the common Diuisor is to be set thus.

The 4. diuidend	7	54	48	40	42	32	0	0	
The diuisor.		13	3	53	56	23	58		

daies ′ ″ ‴ ⁗

(27 | 33 | 16 | 26.

Here asking howe many times 13. is contained in 5. and 54. seeke for 13. in the foote of the Trapezium, in whose collum you shall not finde 5. and 54. but 5. and 51. which is nigheſt vnto

it

it, and right against that in the outermost collum on the left hand you shall find the quotient to be 27. by which if you should multiply the whole Diuisor, the whole product thereof would be 5.56. 21.24. 1.47. 6. which is more then the diuidend, and therefore you must make your quotient one lesse, setting downe no more but 26. in the quotient line, by which if you multiply the Diuisor, the product will bee 5.26.41.22. 25. 14.8. which being subtracted out of the fourth diuidend, the remainder will bee 28. 7. 18. 17. 17,52, which remainder if you will, you may make to be a fift diuidend, and then to worke as before, if you would haue your quotient to extend to smaller denominations, which I leaue to do because I thinke that thirds be small inough. And as often as the product of any particular quotient shall bee greater then the diuidend, remember to take a lesse quotient euen as you doe in common Diuision. But now you haue to note that though this whole quotient here signifieth time, for the first quotient signifieth daies the second quotient minutes of daies, the third quotient seconds, and the fourth quotient thirds, yet for so much as the day is to be counted by 24. houres and not by minutes, you must therefore reduce all the particular quotients sauing the first, into howers and parts of howers, euen to so small denominations as you shall thinke good your selfe, by helpe of this rule which in Diuision of Astronomicall Fractions biddeth to multiply the quotient by 2. and to diuide the product thereof by 5. as here if you multiply the 33. which is the second quotient by 2. the product will bee 66. which being diuided by 5. the quotient will be 13. houres and one sixtie remaining to be kept in minde, wherefore set downe in the place of 3′3. 13. houres, then multiply the third quotient which is 16. by 2. and that will make 32. whereunto if you adde the one 60. in minde it will make in all 92. which being diuided by 5. the quotient will bee 18. and two sixties, which is 120. remaining to be kept in minde, wherefore in steade of 16″. which was the third quotient, set 1′8. of an houre, and then proceede to the fourth quotient which is ″″. which being multiplyed by 2. maketh 52. whereunto if you adde 120. it will make 172. which if you diuide by 5. the quotient will bee 3″4. of an hower, which is to bee set downe in the place of 26. so shall your whole former quotient con-

taine

taine 27. daies, 13. howers, 1′8. of an houre and 3″4. of an houre. And note that as in the Diuision of Astronomicall Fractions to bring the quotients to like denomination, you doe multiply by 2. and diuide by 5. so in Multiplycation to reduce the numbers of the multiplyer being of diuers denominations to one selfe denomination, you must by order reuerse, multiply by 5. and diuide by 2. whereof I haue giuen you an example before, whereas I shew you how to multiply Astronomical fractions according to Gemma Frisius, without the helpe of the Sexagenarie table.

An example shewing how to extract the square roote out of Astronomicall Fractions, by helpe of the Sexagenarie Table.

SUppose the number giuen to be $1'7.''.'''.''''.'''''$. whereof you haue to take the square rote, heere hauing set downe the saide numbers with their proper denominations ouer their heads, as you see in the example following, first set a pricke vnder the last number on the right hand, & then pricke euery other number leauing one voide space betwixt euery two prickes, as you doe when you seeke the square rote of whole numbers or Integrums, as you see here in this example.

Then resort to the table & seek amongst the products

	′	″	‴	⁗
The number giuen	17.	12.	33.	4.
		•		•

which are placed next to the line A.B. as well in the Trapezium as in the Triangle, and see whether you can find the number standing ouer the first pricke on the left hand which is 17. and 12. but not finding it there, you must take that which is nigheſt vnto it & lesse, which you shall find in the Triangle towards B. to be 17. 4. the rote whereof you shall finde both in the head, and also in the outward collum of the Triangle on the right hand to be 3 2. aunswering to the foresaid square rote, which rote you must place behinde the quotient line, then subtract 17. and 4. out of 17. and 12. and there will remaine 8. which is to bee set ouer 12. and the 17. and 12. to be cancelled, that done, double the rote 32. which will be 64. that is to say 1. and 4. and setting 1. vnder 8. and 4. vnder 33. aske how many times 1. is in 8. and there is 8. which

is

is the second quotient by which you must multiply 1. and 4. the product whereof will be 8. and 32. which being subtracted from the vpper number which is 8. and 33. the remainder is 1. which is to be set ouer 33. and the 8. and 33. to bee cancelled. Finally multiply the second quotient 8. in it selfe, and the product will be 1. and 4. which being subtracted out of the former remainder of the giuen number nothing remaineth, so as you shall find 3′2.8″. to be the roote of the giuen number, as this example sheweth.

Which roote if you multiply into it selfe squarely, the product will be like vnto the number giuen, and by this meanes you shall find the giuen number to be a iust square number. But you haue to note that if the last denomination standing on the right hand be od & not euen, as thirds or fifts, then you must set downe a Cypher beyond the last denomination towards your right hand, and vnder that Cypher set your first pricke, as in this example 3′.″.‴.⁗.ˣ. heere because the last denomination on the right hand is od, that is to say fifts, you must therefore set downe next vnto it towardes the right hand a Cypher hauing ouer his head the next denomination which is VI. and is euen, wherefore set your first pricke vnder that Cypher and so proceede towards your left hand pricking euery other number, and then worke as followeth.

```
                 8  ″  ‴
  ′   ′  ″  ‴  ⁗  ′  ″
  1.7.12.33.4.(3′2.8″.
     X  4  4
        1
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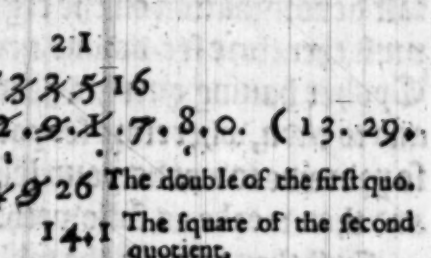
First then seeke in the table amongst the square numbers nigh vnto the line A.B. for 3. and 2. which should stand in one selfe square Angle next vnto the line A.B. for those onely are square numbers, and not finding it amongst the square numbers, take that square which is nighest vnto it and lesse, which you shall find to be 2 and 49. the roote whereof is 13. and is to be found as well in the foote of the Trapezium right vnder the foresaid square number, as also in the outermost collum of the said Trapezium on the left hand standing right against the same square number, which roote is to be set in the quotient line, that done, subtract the foresaid square number out of the number standing right ouer the last pricke on the left hand which

```
                 ″
  ′   ′  ″  ‴  ⁗  ′  ″   VI
  3.2.9.17.8.0.(13.
  2.49.  .  .
```

is

is 3. and 2. and the remainder will be 13. which is to be set ouer 2. and the 3. and 2. to be cancelled as you see in the former example, that done, double the foresaid found roote 13. which will make 26. by which you haue to diuide 13. and 9. wherefore resorte to the Trapezium, in the foote whereof you shall find 26. in whose collum not finding 13. and 9. take that which is nigbest vnto it & lesse, which is 13. and 0. right against which you shall find in the outermost collum on the right hand 30. which should be your quotient, but because it is too great and that the square thereof cannot bee taken out of the remainder, you must make the quotient one lesse, and set in the quotient line no more but 29. by which 29. if you multiply 26. the product will be 12. and 34. as the Trapezium sheweth, which being subtracted out of 13. and 9. standing ouer 26 the remainder wil be 35. which 35 is to be set ouer 9. then by multiplying the second quotient which is 29. into it selfe, you shal find by the Trapezium the product to be 14. and 1. which being subtracted out of 35. and 17. the remainder will be 21. and 16. which is to be set ouer 35. and 17. as you see in this example.

That done, double both the quotients or whole roote, and the product will be 26. 58. and hauing set 58. vnder 8. and 26 vnder 16. diuide 21. 16. and 8. by 26. 58. wherefore looke for 26. in the foote of the Trapezium, and for 21. 16. in that collum, and not finding it there, take that which is nigbest vnto it and lesse, which you shal find to be 21 and 14. & right against that in the outermost collum on the right hand standeth 49. which being too great to be your quotient by 2 therefore make your quotient no more but 47. which being set downe in the quotient line, multiply thereby 26. 58. and the product will be 21. 7. 26. which being subtracted out of 21. 16. and 8. the remainder will be 8. and 42. then setting 42. ouer 8. and 8. ouer 16. cancell 21. 16. and 8. then multiply 47. into it selfe squarely, and you shall find the product thereof in the Triangle to be 36. 49. which being subtracted out of 8, 42. and 0. the remainder will be 8. 6. 1 1. as you see in this example.



The double of the first quo.
The square of the second quotient.

And

And thus you haue found the roote of your giuen number to be 13.29 and 47. and whether you haue done right ly or not, you may know by multiplying the said roote into it selfe squarely, and by adding to the product thereof the remainder, and if you would finde a more exact roote, then adde more Cyphers to your giuen number towardes your right hand, together with their denominations ouer their heads as they encrease successiuely, and be sure alwaies that the number of the Cyphers bee euen and not odde as 2. 4. 6. and so forth, and the more Cyphers that you adde to the giuen number (so as the number of them be euen) the more exact roote you shall haue.

2 2 8 6
2 2 . 3 5 . 2 6 . 4 2 . 11
3 . 2 . 9 . 2 7 . 8 . 8.
2 . 4 9 . 2 6 . 2 5 8 . 4 9
2 2 . 2 4 . 2 6 . 2 6
2 4 . 7 . 3 6
2 2

(13. 29. 47.

Now to giue to euery number of the roote his proper denomination, doe thus, take halfe of those denominations that are ouer euery pricke, and those shall be the denominations of the roote, as in the former example, whereas seconds doe stand ouer the last pricke on the left hand take halfe of that which is 1'. wherefore the first number of your roote must be minutes, and ouer the rest of the numbers of the roote set seconds, thirds and so forth successiuely vntill you haue brought your roote to as small denominations as you desire.

FINIS

FINIS

A BRIEFE DE-
ſcription of the tables
of the three ſpeciall right lines
belonging to a Circle, called Signes, lines Tangent, and lines Secant.

Not only ſhewing why they were firſt inuented, and defining the proper tearmes thereto belonging:

But alſo ſhewing diuers neceſſarie vſes thereof, written by Maiſter *Blundeuile 1593.*

LONDON.
Printed by Iohn VVindet, 1597.

A BRIEF HEDGE.

The Description and vse of the *Tables of Sines.*

BEcause there is no proportion, comparison, or likenes betwixt a right line and a croked, the auntient Philosophers, as Ptolomey and diuers other, were much troubled in seeking to know the measures of a Circle or of any portion thereof by his Diameter, and by knowing the Diameter to finde out the length of any Chorde in a circle, which is alwaies lesser then the Diameter it selfe, and finding that the more parts whereinto the Diameter was diuided, the nearer they approched to the truth: Some of them therefore, as Ptolomey, diuided the Diameter of a circle into a 120. parts, and the Semidiameter into 60. parts, and euery such part into 60. and euery minute in 60. seconds &c. And in like manner did Arzahel, an auntient Arabian, who diuided the Diameter into 300. partes and the Semidiameter into 150. and euery of those parts into 60. and so forth as before, according to which computation they made their Tables: but because the working by those Tables was very tedious and troublesome, by reason that it was needfull continually to vse the art of numbring by Astronomicall Fractions: therefore Georgius Purbachius, and Regio Montanus his Scholer to auoide that trouble of calculating by Astronomicall Fractions, diuided the Diameter of a Circle into a farre greater number of parts, and made such tables as are vsed at this present, the description and vse whereof doth hereafter follow, first of those that are set downe by Monte Regio in Folio, and then of those that were lately Corrected and made perfect by Clauius the Iesuite which are Printed in quarto.

And because that the way to find out the proportion which any chord hath to the whole Diameter, was very hard, therefore the said Purbachius and Monte Regio hauing direction from certaine propositions of Euclyd, as from the 47. proposition of his first booke, and from the third proposition of his third booke, and also from the 15. proposition of his fift booke, they made choise of the halfe chord and Semidiameter of the Circle, calling the halfe chord, Sinum rectum, and the Semediameter Sinum totum. And because that the proportion of any circumference to his diameter neuer changeth, how great or how little so euer the Circle be: after that they had calculated for one Circle, they made such tables as might serue for all Circles, and though these Tables of sines doe suffice to worke thereby all manner of conclusions, as well of Astronomie, as of Geometrie, yet for more ease, our moderne Geometricians haue of late inuented two other right lines belonging to a Circle called lines Tangent, and lines Secant, and haue made like tables for them that were made for sines, and both tables, that is to say, as well of the sines, as of the lines Tangent and Secant, haue one selfe manner of working thereby, as shall plainely appeare hereafter when wee come to describe the same. But first we will beginne with the tables of sines, and plainely define euery terme or vocable of Art, belonging thereunto: The termes are these here following: An arch, a Chord, Sinus rectus Sinus versus, Quadrans, Complementum, and sinus Complementi.

The definitions of the foresaid tearmes.

AN Arch is any part or portion of the circumference of a circle, which in this practise doth not commonly extend beyond 180. degrees which is one halfe of the circumference of any Circle how great or small so euer it be, for euery Circle containeth 360. degrees.

A Chorde is a right line drawne from one end of the Arch to the other end thereof, and note that all chordes are alwaies lesser then the Diameter it selfe, for that is the greatest Chorde in anye Circle.

Sinus rectus is the one halfe of a Chord or string of any Arke which

which is double to the Arke that is giuen or supposed, and falleth with right Angles vppon that Semidiameter which diuideth the double Arke into two equall parts.

Sinus versus that is to say turned the contrary way, is a right line, and that part of the Semidiameter, which is intercepted betwixt the beginning of the giuen Arke and the right Sine of the same Arke, and this is also called in Latine Sagitta, in English a Shaft or Arrowe, for the Demonstratiue figure thereof hereafter following, is not vnlike to the string of a bowe ready bent hauing a Shaft in the midst thereof.

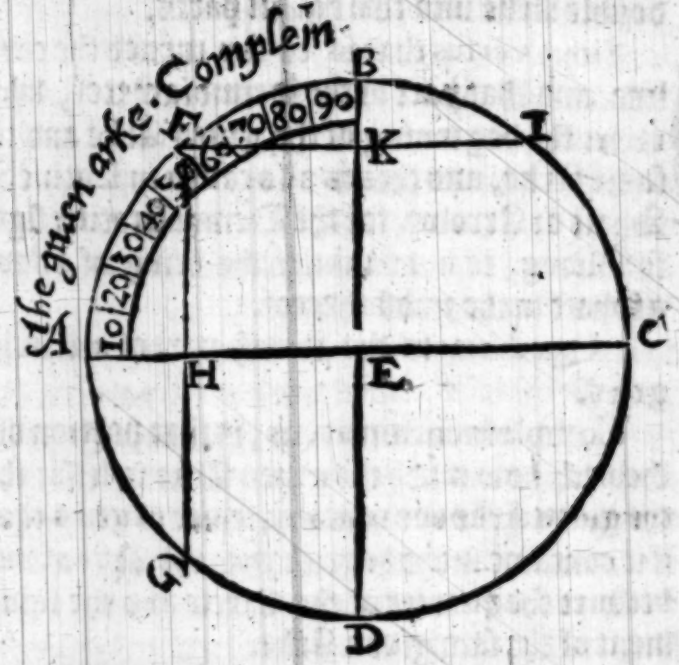
Quadrans is the fourth part of a Circle containing 90. degrées.

Complementum arcus, is that portion of the Circle, which sheweth how much the giuen Arke is lesser then the Quadrant, if the giuen Arke doe containe fewer degrées then the Quadrant, but if it containe more degrées then the Quadrant, then the difference betwixt the quarter of the Circle and the said arch, is the complement of the said giuen Arke.

Sinus complementi, is the right Sine of that Arch which is the complement of the giuen Arke.

Sinus totus, is the Semidiameter of the Circle, and is the greatest Sine that may be in the Quadrant of a Circle, which accordinꝰ to the first tables of Monte Regio containeth 6/000/000. and according to the last tables 10/000/000. parts, for the more parts that the totall Sine hath, the more true and exact shall your worke bee, notwithstanding sometime it shall suffice to attribute vnto the totall Sine but 60/000. parts, which numbers Appian obserueth in teaching the way to finde out the distance of two places differing both in Longitude and Latitude by the Tables of Sines, and some doe make the totall Sine to containe 100/000. partes, as Wittikindus in his treatise of Dials, and diuers other doe the like. Also Clauius himselfe saith that in the tables set downe by him in quarto, you may sometime make the totall Sine to be but 100/000. so as you cut off the two last figures on the right hand in euery Sine, but you shall better vnderstand euerye thing here aboue mentioned, by the figure Demonstratiue heere following.

The figure Demonstratiue.



In this figure you see first a whole Circle drawne vpon the Centre E. and marked with the letters A. B. C D. which Circle by two crosse Diameters marked with the letters A. C. and B. D. & passing both through the Centre E. is diuided into fower Quadrantes or quarters, the vpper Quadrante whereof on the left hand is marked with the letters A. B. E. in which Quadrant, the right perpendicular line marked with the letters F. H. betokeneth the right Sine of the giuen Arke A. F. which right Sine is the one halfe of the chord or string F. G. and the giuen Arke A. F. is the one halfe of the double Arke or bowe G. A. F. and A. H. is the Shaft called in Latine Sinus versus: Againe the letters F. B. doe shew the complement which together with the giuen Arke A. F. doe make the whole Quadrant A. F. B. which is diuided into 9. spaces, euery space containing 10. degrees whereby you may plainely perceiue that in this demonstration, the giuen Arke A. F. is 50. degrees, and the complement F. B. is 40. degrees, both which being added together doe make vp the whole Quadrant of 90. degrees, marked with the letters A. F. B. Now Sinus complementi is the crosse line marked with the letters F. K. the totall Sine which is the whole Semidiameter and greatest right Sine, is marked with the letters B. E. But because it is not enough to know the signification of the things aboue specified to vse the foresaid Tables when neede is, vnlesse you know also

also how to find out those things in the said tables, I thinke it good therefore to shew you the order of the said tables by describing the same as followeth.

You haue then to vnderstand that the tables of Monte Regio printed in Folio, are contained in 18. Pages, and euery Page containeth eleauen partitions, called collums, whereof the first on the left hand containeth 60. minutes, which are to be counted from head to foote, as they stand in order one right vnder another in seuerall places, proceeding from 1. to 60. The second collum containeth Sines. The third containeth onely a portion or part of one second, and from thence forth proceeding towardes the right hand all the other collums doe containe in like manner Sines and the portion of one second. And right ouer the head of euery Sine (the first collum of Sines onely excepted, hauing nothing but a Cypher ouer his head) are set downe the degrees of the whole Quadrant called arches, in such order as from the first Page to the last there are in all 89. degrees, or arches, as by perusing the said tables you may plainely see. Now to find out in these tables the things aboue mentioned, you must doe as followeth.

First to find out the right Sine of any giuen Arke, you must seeke out the number of the said Arke in the front of the tables, and if the giuen Arke hath no minutes ioyned thereunto, then the first number of Sines right vnder the said Arke, is the right Sine thereof. But if it hath any minutes ioyned thereunto, then you must seeke out in that Page, where you found the giuen Arke, the number of the minutes in the first collum of the said Page, on the left hand, and right against those minutes on the right hand, in the square Angle right vnder the said arch, you shall find the right Sine. As for example, you would find out the right Sine of a giuen Arke containing 8. degrees, and 20. heere hauing found out in the front of the second Page the figure of 8. standing right ouer the eight collum, seeke in the first collum on the left hand of the said Page, for 20. minutes, and right against the 20. minutes you shal find on the right hand in the common Angle or square 869593. which is the right Sine of the foresaid giuen Arke, so as you make 60000000. to be the totall Sine: but if you make 60000. the totall Sine, then you must alwaies reiect the two last figures standing on the right hand of the said right line, & the rest of the figures shall be the right Sine.

Now to find out the complement, there is nothing to be done, but onely to subtract the giuen Arke out of the whole Quadrant which is 90. degrées, and the remainder shall be the complement: as in the former example by subtracting 8. degrées, 2′0. out of 90 degrées, you shal find that there remaineth 81. degrées, 4′0. which is the complement of that arch. Againe to find out the Sine of the complement you must doe thus, seeke the complement in the front of the tables of Sines, euen as you doe to find out any giuen arke: as in the former example, the complement being 81. degrées 4′0. you must seeke 81. in the front of the 17. Page of the first tables, which being found, seeke out also the 4′0. in the first collum of the said Page on the left hand, and right against those 4′0. in the common Angle right vnder the Arke 81. you shall finde 5/936/649. which number is the right Sine of the foresaid complement, so as you make 6/000/000. to be the totall Sine, for if 60/000. be the totall Sine, then you must reiect (as I said before) the two last figures on the right hand, and the number remaining shall bee the right Sine of the foresaid complement, and therefore in working by these tables, you must alwaies remember what number you make the totall Sine to be.

Sinus versus commeth seldome in vse, notwithstanding if you would know how to find it out, you neede to do no more but to subtract Sinum complementi of the giuen Arke, out of the totall Sine, and the remainder shall bee Sinus versus, as in the former example your Sinus complementi was 5/936/649. which being subtracted out of the totall Sine 6/000/000. there remaineth 63/351. and that number is Sinus versus: for if you adde this remainder to the number which you subtracted, it will make vp the totall Sine 6/000/000. But there is one thing more necessarie to be knowne then this, because it commeth oftner in vse, and that is vpon some diuision made how to find out the Arke of any quotient, which is to be done thus: Enter with the quotient into the body of the tables, and leaue not seeking amongst the squares of the Sines, vntill you haue found out the iust number of the quotient (if it be there) if not, you must take the number of that Sine which is in value most nigh vnto it, whether it bee a little more or lesse, it maketh no matter, and hauing found that number, looke in the front of that collum, and you shall find the Arke of your quotient

ent, standing right ouer the head of that collum, and also the mynutes thereof in the first collum of the said Page on the left hand. As for example, hauing diuided one number by another, I finde the quotient to be 469/012. whereof I would know the arch, now in seeking this quotient amongst the Sines, I can not finde that iust number, but I find in the first Page, and in the tenth collum 469/015. which is the nigheſt number vnto it that I can see. In the front of which collum I find the Arke to be 4. degrees, and directly against that Sine on the left hand, I find 2′9. belonging to that arch, whereof that quotient is the Sinus, so as I gather hereof that the arch of the foresaid quotient is 4. degrees, 2′9. But you haue to note by the way that the number of your quotient must neuer be much lesse then 1745. for otherwise it is not to bee found in these tables, vnlesse you make the totall Sine to bee but 60/000. for then by reiecting the last two figures on the right hand, as I haue said before, the first right Sine of these tables shal be no more but 17. and by that account a very small quotient may be found in these tables. And whatsoeuer hath beene said here touching the order that is to be obserued in the first tables of Monte Regio, whose totall Sine is 6/000/000. the like in all points is to be obserued in the last tables, whose totall Sine is 10/000/000. Thus much touching the order of the foresaid tables of Monte Regio Printed in Folio: but for as much as those tables be not altogether truely Printed, and for that they haue beene lately corrected, and made more perfect by Clauius, who doth set downe the saide Tables in quarto and not in folio, whereby they are the more portable, and the more commodious, as well for that they are more truely Printed, as also for that the complement of euery Arke is set downe in euery Page at the foote of euery collum, so as you néd to spend no time in subtracting the Arke from 90. I thinke it good therefore to make a briefe description of those Tables, and the rather for that I haue requested the Printer to print the like here in quarto, and I doe worke all such conclusions as hereafter follow, by the said tables, the totall Sine whereof is 10/000/000. according to the last tables of Monte Regio. But for so much as some may haue already the tables of Monte Regio Printed in Folio, not knowing perhaps the vse thereof, I will set downe two conclusions to bee wrought by those tables, and all the rest of the conclusi-

ons are to be wrought by these tables which I haue here caused to be Printed in quarto like to those of Clauius: and though the two conclusions next following, which are to shew the vse of the foresaid tables, may be wrought by the tables of Sines in what forme so euer they be truely Printed in Folio, or in quarto, yet because I had appointed them to bee done by the Tables of Monte Regio, Printed in folio before that euer I saw Clauius his booke, I mind not now to alter them but to let them stand still as they are.

How to find out by the saide tables, the distance betwixt two places differing both in Longitude and Latitude, making the totall Sine to be no more but 60/000.

THis is done by finding out two numbers, whereof the one is called in Latine Primum inuentum, that is to say, the first found number, and the other is called Secundum inuentum, that is the second found number in such order as followeth.

First then knowing the Longitude of either place, take the differẽce of their Longitudes by subtracting the lesser Longitude out of the greater, that done, multiply the right Sine of that difference into the Sine of the complement of the lesser Latitude, and diuide the product of that Multiplycation by the totall Sine, and then seeke out the arch of that quotient according to the rule before taught, so shall you haue the first found number: That done, multiply the right Sine of the lesser Latitude by the totall Sine, and hauing diuided the product thereof by the right Sine of the complement of the first found number, subtract the arch of that quotient out of the greater Latitude, and you shall haue the second found number: Then multiply the right Sine of the complement of the first found number into the right Sine of the complement of the second found number, and hauing diuided the product of that Multiplycation by the totall Sine, seeke the Arke of that quotient in the tables, and take that Arke out of the whole Quadrant, and the degrees that doe remaine, are degrees of the great Circle, which if you multiply by 60. the product of ỹ Multiplycation will shew you how many Italian miles the one place is distant from the other, or if you would haue Germane miles, thẽ multiply the foresaid degrees of the great Circle by 15. or else diuide the product

of

of the Italian miles by 4. and you shall haue your desire. As for example, you would know what distance is betwixt Hierusalem and Noremberg a famous towne in Germanie, Hierusalem according to Appian his tables, hath in Longitude 66. degrees 0′. and in Latitude 31. degrees, 4′0. Againe Noremberg hath in Longitude 28. degrees, 2′0. and in Latitude 49. degrees, 2′4. the difference of their Longitudes is 37. degrees, 4′0. the right Sine whereof is 36/664 for in this example Appian maketh 60/000. to be the total Sine, and therefore he reiecteth the two last figures on the right hand found in the first tables of Monte Regio Now you must multiply 36/664 into the right Sine of the complement of the lesser Latitude which Sine is 51/067. the product of which two Sines being multiplyed the one by the other, amounteth to 1/872/320/488. which if you diuide by the totall Sine. 60/000. you shall find in the quotient 31/205. whose arch is 31. degrees, 2′0. and this shal be your first found number. This done, multiply the right Sine of the lesser Latitude which is 31/498. by the totall Sine 60/000. and the product thereof will be 1/889/880/000. which summe if you diuide by the Sine of the complement of the first found number which Sine is 51/249. you shall find in the quotient 36876. the Arke whereof is 37. degrees 5′5. which arch being subtracted out of the greater Latitude, there will remaine 11. degrees, 2′9. and that shall be your second found number, then multiply the foresaid Sine of the complement of the first found number which is 51/249. by the Sine of the complement of the second found number which is 58/798. and the product thereof will amount to 3/013/338/702. which if you diuide by the totall Sine, you shall find in the quotient 50/222. the arch whereof is 56. degrees, 5′0. which being subtracted out of the whole Quadrant which is 90. degrees, there will remaine 33. degrees, 1′0. of the greater Circle, which 33. degrees, if you multiply by 60. it will make 1980. miles, whereunto you must adde for ỹ 1′0. 10. miles, so shall you find the distance betwixt the two foresaid places to be 1990. Italian miles, which if you would reduce into Germaine miles, then diuide that number by 4. for 4. Italian miles doe make but one Germaine mile, so shall you haue 497. Germaine miles, and two Italian miles remaining, which is halfe a Germaine mile, which summe agreeth with that which

Appian

Appian ſetteth downe in his Geographie, whereas hee vſeth the ſelfe ſame example, and worketh it in like manner Per tabulas ſinuum.

The Altitude of the ſunne being knowne, how to find out the Longitude of the ſhadow both right and verſe of any body yeelding ſhadow by helpe of the foreſaid tables.

FIrſt you haue to vnderſtand that euery bodily thing yelding ſhadow, is diuided into 12. equall partes, and euery ſuch part into 60. minuts, and euery minute into 60. ſeconds, and ſo forth: Againe, of ſhadowes there bee 2. kindes, that is, Vmbra recta, and Vmbra verſa: Vmbra recta is that which proceedeth from ſome body rightly erected vpon the vpper face of the Horizon, as from ſome tower or poſt ſtanding right vp vpon a leauel ground: And that ſhadowe is called Vmbra verſa which proceedeth from ſome right ſtyle or pearch being thruſt into a wall or poſt ſtanding right vp and not leaning, in ſuch ſort as the ſayde ſtyle or pearch may bee a iuſt paralell to the vpper face of the Horizon. Now to find out the length of either the foreſaide ſhadowes, you muſt doe thus.

Multiply the right Sine of the complement of the giuen Solar altitude, by 12. and diuide the product by the right Sine of the ſaid Solar altitude, and you ſhall haue the Longitude of the right ſhadow of the ſaid body. Againe if you multiply the right Sine of the foreſaid altitude by 12. and diuide the product by the Sine of the complement of the ſaid altitude, you ſhall haue the Longitude of Vmbra verſa, of the ſaide body. As for example, ſuppoſe the giuen Solar altitude to be 25. degrees, the complement whereof is 65. and the right Sine of that complement is 54/378. if you make the total Sine to be 60/000. Then in multiplying the foreſaid right Sine by 12. the product will be 652/536. which if you diuide by the Sine of the altitude which is 25/357. you ſhall find the longitude of Vmbra recta to be 25. parts 4′ 4 4″ 2. q 6′. Now if you multiply the Sine of the altitude which is 25/357. by 12. and diuide the product by the Sine of the complement which is 54/378. you ſhall finde the Longitude of Vmbra verſa to bee 5. parts, 35. and in ſaying here parts, I meane alwaies ſuch parts

as

as are the 12. parts, whereinto the body yelding shawdowis diuided: but if you worke this example by the first tables of Sines making the totall Sine 6/000/000. though you finde it true in the parts and minutes, yet shall you not finde it so in the seconds and thirds: and if you worke the same by the second tables making the total Sine 10/000/000. you shal find it to agree only in the parts, but neither in minutes nor seconds, which maketh me to suspect that the Printer hath committed some error therein, for both the tables were made by one selfe rule.

A briefe description of the tables of Sines Printed in quarto like vnto those which Clauius setteth downe in his commentaries vpon Theodosius his Spheriques.

HAuing heere before plainely described vnto you the tables of Sines made by Monte Regio, which are Printed in folio, & how to vse the same, I wil now briefly describe the said tables lately corrected by Clauius, and were Printed in quarto at Rome Anno 1586. the totall Sine of which tables according to the last table of Monte Regio, is 10/000/000. by which Tables are to be wrought all the conclusions hereafter following.

First then you haue to vnderstand that these table are contained in 36. Pages, in the front whereof are set downe the degrées of the Quadrant proceeding from 1. to 89. but because the whole number of minutes belonging to the saide degrée, which is 60. can not be all placed in one selfe Page, but onely 30. in the left outermost collum of the left hand Page: and other 30. in the left outermost collum of the right hand Page: therefore the degrées or arches of the Quadrant are faine to be twice repeated in the front of euery two Pages, as you may plainely sée by viewing the said tables, and euery Page containeth seauen collums, whereof the first on the left hand containeth the minutes belonging to the degrées or arches of the Quadrant, which minutes do proceed downward from 1. to 30. and the seauenth collum on the right hand in euery Page containeth the minutes belonging to the complement of euery arch, which minutes doe proceede backward, that is to say from 1. set downe at the lowest end of the last collum of the second Page, and so proceeding vpwarde to 30. which 30. is also set

downe

downe at the lowest end of the last collum of the left hand Page, and so proceedeth vpward to 60. which 60. minutes doe helpe to make vp the complement that is answerable to euery arch whereunto no minutes be annexed, for if the arch hath no minutes, then you must adde to the complement thereof 60. minutes, which is one whole degree, to make vp the complement. As for example, suppose the Arke to be 46. degrees, without any minutes ioyned thereunto, the complement whereof set downe at the foote of the said arch, is but 43. degrees, wherefore you must adde thereunto 60. which is one degree, so shall the complement be 44. degrees, which is the true complement indeede, but if you suppose the foresaid Arke to haue 13 ioyned thereunto you shall find the complement to be 43. degrees, 47. which is answerable to the foresaide Arke 46. degrees, and 13. for if you take 46. degrees, 13. out of 90. degrees, the remainder will be 43. degrees, 47. which is the complement, so as you neede not to make any Subtraction out of 90. to find the complement of any arch, that hath any minutes annexed thereunto: but when so euer you haue to finde out the right Sine of any complement in these tables, you must then make the complement an arch, seeking for the same in the front and not at the foote of the tables, & if the said complement haue any minutes annexed thereunto, you must seeke those minutes in the left outermost collum of euery Page, and not in the outermost right collum belonging to complements, for in this case the complement is an arch and not a complement. The order of working by these tables in all other things differeth not one iotte from that which we haue obserued in working the two former conclusions by the tables of Monte Regio Printed in folio, as you shall easily perceiue by the examples here following.

1 How to find out the declination of the Sunne at any time his place in the Zodiaque being giuen. *Per tabulas Sinuum.*

KNowing the place of the Sun for the day, consider how much the said place is distant from the first point of Aries if ỳ place of the Sunne be nigher to Aries then to Libra. But if it be nigher to Libra, then take his distance from the first point of Libra, which distance must not exceede 90. degrees, and seeke that distaunce a-

mongst

mongst the Arkes in the front of the Tables if they be degrées, if minutes, you shall finde them in the first collum on the left hand, then multiply the Sine of that distance by the Sine of the greatest declination which is 23. degrées, 28. and diuide the product therof by the total Sine, and the quotient wil shew you the Sine of the declination for that day, the arch whereof, is the very number of the declination it selfe. As for example, you would know the declination of the Sunne the eleauenth of Aprill 1591. when as the Sunne was entred 3°3. into Taurus vnto which you must adde according to the rule before giuen 30. degrées, for that is his distance from the first point of Aries, then seeke out the said 30. degrées, in the front of the last Tables among the Arkes and the 3°3. in the first collum on the left hand right against which you shall find the Sine of the saide distance to bee 5082/901. which being multiplyed by 3/982/155. (which is the Sine of the greatest declination) the product thereof will be 20/240/890/631/655. which if you diuide by the totall Sine which is 10/000/000. you shall find the quotient to be 2/024/089. which quotient must be sought out in the said Tables, and if you find no such number, then take the nearest number thereunto, which is 2025025. and the Arke thereof together with the minutes that stand right against the said quotient in the first collum on the left hand, is the declination of the Sunne for that day wich is 11. degrées, 41.

2 How to know the right ascention of the Sunne, *Per tabulas Sinuum.*

FIrst knowing the Sunnes place, you shall learne the right ascention therof thus. First consider how farre his place is from the Equinoctiall point, as is saide before in the last proposition, and multiply the Sine of the complement of that distance by the totall Sine, then knowing the declination of the Sunne for that day by the last rule, diuide the former product by the Sine of the complement of the said declination, and the quotient will shew the Sine of that Arke whereof the complement is the right ascention. As for example, the Sunne being in the 3°3. of Taurus and his declination 11. degrées, 41. as you found by the last proposition & his distance frō the first point of Aries to be in all 30. degrées 3°3.

the

the complement whereof is 59. degrées, 27. the Sine of which complement is 8611860. which being multiplyed by the totall Sine which is 10000000. the product will be 86111600000000. which being diuided by the Sine of the complement of the Sunnes declination which is 78. degrées, 19. whose Sine is 9792813. by which Sine if you diuide the former product, the quotient will bee 8773600. the Arke of which quotient is 61. degrées, and 19. and the complement of that is 28. degrées, and 41. which is the right ascention of the place of the Sunne for the foresaid day.

And here note that if the Arke from Aries to the giuen pointe, doe containe iust 90. degrées, the right ascention thereof is also 90. degrées, but if the said Arke bee more then 90. degrées, and lesser then 180. degrées, then subtract the same out of 180. and seeke out the right ascention of the remainder as before, whose right ascention if you take out of 180. the remainder shall bee the ascention of the propounded Arke. But if the said Arch which is comprehended betwixt Aries and the giuen pointe bee greater then 180. degrées, or 6. signes, and lesser then 270. degrées, or 9. signes, then hauing subtracted 180. degrées from the same arch, calculate the right ascention of the arch from the beginning of Libra, as before, and the right ascention thereof being added to 180. degrées, shall be the ascention desired.

Lastly if the arch comprehended betwixt Aries and the pointe giuen, be greater then 270. degrées, or 9 signes, then subtract the same out of 360. degrées, and seeke out the right ascention of that remainder as before, which if you subtract out of 360. degrées, the remainder shall be the right ascention desired.

3 How to finde out the ascentionall difference, *Per tabulas Sinuum.*

MUltiply the Sine of the Latitude giuen by the total Sine, and diuide the product by the complement of ỳ said Latitude, that done, multiply the quotient by the Sine of the sunnes declination, and diuide the product by the Sine of the complement of the declination, and the quotient thereof will shew the signe of the ascentionall difference: and by working according to this rule, you shal find

that

that when the Sunne is entred 3′3. into Taurus, at which time his declination is 11. degrees, 4′1. (as haue beene saide before) the ascentionall difference will be 15. degrees, 2′1. And heere note that the ascentionall differences for one quarter of the Circle serueth also for all the rest, so that the Latitude bee not altered, and that the declination of the points in the later quarters be equall to the declination of the points in the first quarter.

4 How to find out the oblique ascention of any pointe of the Ecliptique in any Latitude assigned.

FIrst finde the right ascention of the giuen pointe by the second proposition, & also the ascentional difference therof by the third proposition: thē consider whether the declination of the said point be Northward or Southward, for if it be northward, then subtract the ascentionall difference out of the right ascention, and the remainder shall be the oblique ascention desired: but if the declination be Southward, then adde the ascentionall difference vnto the right ascention, and the summe shall be the oblique ascention. In working thus for the Latitude 52. and suppose the Sunne to bee in the 3′3. of Taurus, and hauing found by the former proposition his right ascention to be 28. degrees, 4′1. and the ascentional difference to be 15. degrees, 2′1. you shall find his oblique ascention in the foresaid Latitude to be 13. degrees, 2′0.

5 How to finde out the time of the Sunnes rising and setting, and thereby the length of the artificiall day.

FIrst you must know the ascentional difference, and conuert the same into howers & minutes, then if the Sunne be in any of the northern signes, adde those howers to 6. howers which is the one halfe of an Equinoctiall day, and the summe of such Addition shall be the one halfe of the artificial day, which being substracted out of 12. howers, the remainder shal be the hower of the Sunnes rising: As for example, the Sunne being in the 3′3. of Taurus, you found the ascentionall difference to be 15. degrees, and 2′1. which being turned into howers maketh one hower 1′. ″/3. and somewhat more, which being added to 6. maketh 7. howers 1′. ″/2. and a little more

which

which is the one halfe of the artificiall day which being doubled, maketh in all 14. howers 2′. and 4″. but if the Sunne be in any of the Southerne signes, you must remember to subtract ỹ howers of the ascentionall difference out of 6. howers, and the remainder shall be the one halfe of the artificiall day, and by subtracting the halfe length of the artificiall day out of 12. you shall know the hower of the Sunnes rising, and hauing the time of his rising, you must nedes know the time of his setting.

6 How to find out the Meridian altitude of the Sunne in any day though he do th not shine at all, the eleuation of the Pole being giuen.

SUbtract the eleuation of the pole from 90. and the remainder shall be the eleuation of the Equinoctiall, then if the Sunne be in any of the Northern signes, adde the declination of the Sunne, vnto the altitude of the Equinoctiall, or else if he bee in any of the Southern signes, subtract the declination, and the summe of the Addition, or remainder of the Subtraction, shall shew the Meridian altitude. As for example, the second of May 1591. the sunne being in the 20. degrees, 4′ 2. of Taurus, and his declination Northward 17. degrees, 5′ 6. 2″ 1. heere by subtracting 52. degrees, which is our Latitude from 90. you shall find the remainder to be 38. which is the altitude of the Equinoctiall, whereunto if you adde the Sunnes declination for that day which is 17. degrees, 5′ 6. and 2″ 1. the summe will bee 55. degrees, 5′ 6. and 2″ 1. and that is the Meridian altitude of the Suune for that day.

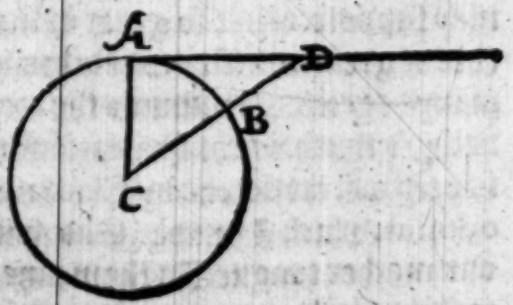
Let these few conclusions serue to shew you the vse of the Tables of Sines, for it would make a long booke to set downe so many conclusions as are to bee wrought by these Tables, and therefore I leaue to trouble you any further therewith, minding now briefly to declare vnto you the vse of the Tables of lines Tangent and Secant by one example or two as followeth. But first I thinke it necessarie to shew you what those lines bee, and where to they serue.

THE

THE DESCRIPTION and vse of the Tables of Tangents and Secants.

EVclid in the second proposition of his third Booke defineth the line Tangent in this sort. A right line (saith he) is said to touch a circle when it toucheth it so, as being drawn out in length, it woulde neuer cut the saide Circle.

The line Secant is not by him any wher defined, but what these two lines are, you shall better vnderstand by this figure Demonstratiue here following, then by any definition that can be made thereof: for a definition ought to bee plaine and briefe, and not long, intricate or doubtfull, which will be hardly performed in shewing the nature of these two lines by way of definition, and therefore marke well this figure following.



In this figure you see first a Circle drawne vpon the Centre C. from which Centre is extended to the circumference of the Circle a right line, called the Semidiameter, marked with the letters A.C. then there is another right line which toucheth the said Circle, and also the outermost end of the said Semidiameter making therewith a right Angle in the point A. and is called the line Tangent then ther is a third line which proceeding from the Centre C. doth cut the circumference of the Circle in the point B. & also meeteth with the line Tangent in the point D. and therfore is called ỹ line Secant, betwixt which two lines, I meane the Tangent & Secant, is intercepted or included a certaine por-

tion or arch of the foresaid Circle, lesse then a Quadrant marked with the letters A. B. of which Arke the line A D is the Tangent, and the line C. D. is the Secant thereof, which must nedes mete with the Tangent in the point D. because that the two Angles C. A. D, and D. C. A. are lesser then two right Angles, for the one is right, and the other sharpe, by reason that the Arke is lesse then a Quadrant. And some doe call the line Tangent the line Ascript, because it is ascribed to the Circle, and they call the line Secant the *Hipothenuse*, because it subtendeth the right Angle A. & they call the Semidiameter or totall Sine, the base of ỳ rectangle Triangle C. A. D. which is called a rectangle Triangle because it contayneth one right Angle marked with the letter A. and note that whensoeuer any maner of Angle is propounded by thré letters, that the middle letter doth alwayes signifie the Angle propounded, bee it right, sharpe, or blunt. Now if you would know to what ende the foresaid two lines were inuented, and wherto they serue, you haue to vnderstand that they chiefly serue in calculating the quantitie of Angles and their sides, as well in right lined Triangles as in spherical Triangles, for the sides of Triangles are either right or crooked, and if they haue right sides, such Triangles are eyther right angled Triangles, or oblique angled Triangles, and you haue to note that the quantitie of euery Angle is to be measured by the arch of a Circle subtending that angle, for the point of euery Angle is imagined to be the Centre of a whole Circle, which you may suppose to bee so great or little as you will, for euery Circle (bee it great or little) is deuided into 360. degrées, and looke how many degrées and minutes the arch subtending that Angle containeth, so much is the quantitie of that Angle, the practise whereof is very wel set downe by Clauius in his commentaries vpon Theodosius, which I minde (God willing) hereafter to translate into our mother tongue: In the meane time my intention here, is onely to shew you by one example or two, the vse of the Tables made for the foresaid lines Tangent and Secant.

The vse of the said Tables according to Clauius, is thus.

IN séeking out the Tangent or Secant of any Arke giuen, or of the complement of any Arke by either of these Tables, you haue

to.

to obſerue the ſelfe ſame order which you did before in finding out the right Sine of any Arke giuen, or of the complement of any Arke, Per tabulas ſinuum. As for example, if you would finde out the Tangent of an Arke containing 50. degrees, 2′4. then reſort to the Table of Tangents in the front, wherof looke firſt for the Arke 50. degrees, and then in the firſt collum on the left hand of the ſaid table, for 2′4. right againſt which on the right hand vnder the Arke 50. you ſhall finde in the common Angle the Tangent to bee 1 2/087/923. the total Sine wherof is 10/000/000. but if you would find out the Secant of the foreſaid Arke 50. and 2′4. then you muſt reſort to the table of Secants, and hauing found out the Arke 50. in the front of the ſaid Tables, and the 2′4. on the left hand as before, you ſhall find in the common Angle the Secant to be 1568814. And if you would haue the Tangent of the complement of the ſaid Arke which is 39. degrees, and 3′6. you ſhall find the 39. degrees of the complement in the foot of the table of Tangents right vnder the Arke 50. & the 3′6. in the outermoſt collum on the right hand of the ſaid table, with which complement you muſt enter the table of Tangents, ſeeking for 39. degrees in the front of the table, and 3′6. in the firſt collum on the left hand of the ſaid table, right againſt which in the common Angle you ſhall finde 8272720. to be the Tangent of 39. degrees, 3′6. which is the complement of 50 degrees, 2′4.

And you muſt worke in like manner with the table of Secants: As for example, if you would find the Secant of 72. degrees, 3′6. firſt then enter the table of Secants, looking for 72. degrees aboue in the front of the table, and 36. in the firſt collum on the left hand of the ſaid table, and in the common Angle you ſhall find 33/440/240. which is the Secant of 72. degrees, 3′6. But if you would haue the Secant of the complement of the ſaid arch 72. degrees, 3′6. then looking in the foote of the Table right vnder 72. degrees, you ſhall finde 17. degrees, and in the outermoſt collum on the right hand, iuſt againſt 3′6. you ſhall find 2′4. ſo as you ſee that 17. degrees 2′4. is the complement of 72. degrees, 3′6. with which complement you muſt enter the Table of Secants, looking for 17. degrees, aboue in the front of the Table, and for 2′4. in the firſt collum on the left hand of the ſaid tables, & in the common Angle you ſhall find 10/479/542. to bee the Secant of the arch 17.

degrées,2′4.which is the complement of the arch 72.degrées,3′6.

The vse of which tables in Astronomicall matters, I haue here set *downe as followeth.*

1 To finde out the declination of the Sunne, the place thereof being knowne.

MUltiply the Secant of the complement of the greater declination by the totall sine, & deuide the product by the sine of the Suns distance frō one of the Equinoctial points, the quotient is the Secant of an arch, whose complement is the declination of the Sun: for example, suppose that the sunne be entering into ♉ to find the declination therof, first I multiply 25112030.the Secant of 66.degrées 3′2.(which is the complement of 23.degrées 2′8.the greatest declination)by 10000000.the product is 251120300000000.which being diuided by 5000000.(the sine of 30.degrées the Sunnes distance from the Equinoctiall point)the quotient is 50224060.for which number I seeke in the Table of Secants, the arch answering vnto it,is 78.degr.3′2.the complement wherof is 11.degrées 2′9.which is the declination of the Sunne.

2 Knowing the declination of the Sunne how to finde his distance from the Equinoctiall point, and so consequently his place in the Zodiacke.

MUltiply the Secant of the complement of the greatest declination by the totall sine, & deuide the product by the Secant of the complement of the declination giuen,the quotient is the distance of the Sun from the Equinoctiall point. As for example, the declination of the sun is supposed to be 11.degrées 2′9.then to finde

find his distance from the Equinoctiall, I multiply 25112030. the Secant of 66. degrées 3′2. (which is the complement of the greatest declination) by the totall sine the product is 2511203000000000. which I diuide by 50224350. the Secant is 78. degr. 3′1. the complement of 11. degrées 2′9. the supposed declination, the quotient is 5000000. the sine whereof is 30. degrées 0′. which is the distance of the Sunne from the Equinoctiall: then for his place you must take the same according to the season of the yeare: for if it be in Aprill, then the Sunne is entring into Taurus, but if it be in August it is entering into Virgo, and being in October, it is entring into Scorpio, and being in Februarie it is in the beginning of Pisces.

3 To find out the right ascention of the Sunne.

MUltiply the Tangent of the distance of the Sunne from the Equinoctiall point which is neerest vnto it, by the signe of the complement of the greatest declination, and diuide the product by the total signe, the quotient is the Tangent of the right ascention of the Sunne, for which if you seeke in the Table of Tangents, the arch answering vnto it is your desire: For example the Sunne being in the first of Taurus, to knowe the right ascention thereof, I multiply 5773502. the Tangent of 30. degrées (for that 30. degrées is the distance of the Sun from the Equinoctiall point) by 9172920. the sine of 66. degrées 3′2. which is the complement of 23 degrées 2′8. the greatest declination, the product is 52959871965840. which being deuided by 10000000. the totall sine, the quotient is 5295987. which is the Tangent of 27. degrées, 5′4. which is the right ascention of the Sunne beeing entered into Taurus.

4 How to find out the declination of the Sunne knowing onely the right ascention thereof.

MUltiply the Tangent of the complement of the greatest declination by the total sine, and diuide the product by the sine of the right ascention giuen, the quotient is the Tangent of the complement of the Sunnes declination: for example the right as-

ention of the Sunne being 27. degrées 5′4. I would know the declination thereof, multiplying 23035062. the Tangent of 66. degrées 3′2. the complement of 23. degrées 2′8. by 10000000. the product is 230350620000000. which being deuided by 4679298. the ſine of the giuen aſcention the quotient is 49224856. the arch of which Tangent is 78. degrées 3′2. which being ſubducted out of 90. the remainder is 11. degrées 2′8. and ſo much is the declination of the Sunne.

5 How to finde the place of the Sunne knowing onely the right aſcention thereof.

SUbduct the right aſcention giuen out of 90. if it be leſſe then 90 but if the ſame bee moze then 90. ſubtract the aſcention giuen out of 180. and being greater then 180. ſubduct the ſame out of 270. oz being greater then 270. ſubduct the ſame from 360. and multiply the Tangent of the remainder by the ſine of the complement of the greateſt declination, and deuide the pzoduct by the totall ſine, the quotient is the Tangent of the complement of the Suns diſtance from one of the Equinoctiall points: which diſtance being knowne, the place of the Sunne can not be knowne. Foz example, ſuppoſing the right aſcention of the Sun to be 27. degrées 5′4. the complement thereof is 62. degrées 6′. the Tangent wherof is 1888715. which being multiplyed by 9172920. the pzoduct is 17324598575780 0. which being deuided by 10000000 the quotient is 17324598. foz which I loke in the table of Tangents, and I finde the arch thereof to be 60. the complement wherof is 30. which is the diſtance of the Sunne from the Equinoctiall point, that is, from Aries, foz that the right aſcention is leſſe then 90. I ſay then that the Sunne is in the beginning of Taurus. But if the right aſcention had bẽne moze then 90. and leſſe then 180. the place of the Sunne had bẽne betwixt Cancer and Libra 30. degrées from Libra, ſo ſhould it haue bẽn in the firſt point of Virgo, but if the right aſcention had bẽne moze then 180. the place of the Sunne ſhould be betwixt Libra and Capricorne, that is in the beginning of Scorpio, but being moze then 270. the place of the Sun ſhould be betwixt Capricorne and Aries, that is in the beginning of Piſces.

6 To find out the aſcentionall difference of the Sunne or any ſtarre in the firmament, knowing the declination thereof, and alſo the Latitude of your Region.

MUltiply the Tangent of the declination of the ſunne or ſtar by the Tangent of the Latitude of the place, and deuide the product by the totall ſine: the ſine of the quotient is the ſigne of the aſcentionall difference, the arch whereof is the deſired aſcentional difference. For example let the declination of the Sunne, ſtarre, or other point in the firmament be 10. degrées 3'. and ſuppoſe the latitude to be 52. degrées, the Tangent of 10. degrées 3. is 1772268. the Tangent of 52. degrées is 12799416. which being multiplyed together, the product will be 22674995395488. which being deuided by 10000000. the totall ſine, the quotient is 2267499. for which number I looke amongſt the ſines, the arch anſwering thereunto is 13. degrées 6'. which is the aſcentionall difference deſired.

7 To find out the oblique aſcention of the Sunne.

KNowing the place of the Sunne, find out the right aſcention of the ſame by the third propoſition, and find alſo the aſcentional difference of the ſame point, then if the declination of the Sun be North, ſubduct the aſcentional difference out of the right aſcention, the remainder is the oblique aſcention. For example, ſuppoſe the Sunne to be in the beginning of Taurus, now to finde the oblique aſcention thereof in the Latitude of 52. degrées, firſt by the third propoſition I find out the right aſcention of the beginning of Taurus, which I find to be 27. degrees 5'4. then by the ſixth propoſition I find the aſcentional difference to be 15. degrees 4. which being ſubducted from 27. degrees 5'4 (for that the declination is North) the right aſcention the remainder is 12. degrees 5'0. & ſo much is the oblique aſcention for the latitude of 52. degrees. But if the Sunne be in any of the Southern ſines, and that the declination be South, then the aſcentionall difference is to be added vnto the right aſcention before giuen.

8 To finde out the oblique descention of the Sunne at any time.

FIrst find out the right ascention of the Sunne by the third proposition, the same shall bee the right descention thereof, then finde the ascentionall difference by the sixt proposition, and if the Sun be in any of the Northerne signes, adde the ascentional difference vnto the right ascention, the summe shall be the oblique descention of the Sunne: but if it be in any of the Southerne signes, subduct the ascentionall difference out of the right ascention, the remainder is the desired descention: as for example the sunne being in the beginning of Taurus, the right ascention thereof by the third proposition is 27. degrees 5′4. the ascentionall difference thereof by the sixth proposition is 15. degrees 4′. for as much then as Taurus is a Northerne signe, I adde the ascentionall difference vnto the right ascention, the summe is 24. degrees 5′8. & so much is the oblique descention of the Sunne being in the beginning of Taurus.

9 To find out the length of the day or night.

HAuing found out the ascentionall difference by the sixth proposition, adde the same vnto 90. if the sunne be in any of the Northerne signes, but if it be in any of the Southerne signes, subduct the ascentionall difference out of 90. then diuide the summe of the addition or the remainder of the subtraction by 15. the quotient will shew the halfe length of the day in houres and minutes, which being doubled you shall haue the whole length of the artificiall day: For example the Sunne being in the beginning of Taurus, the ascentionall difference thereof is 15. degrees 4′. which for that the Sunne is in a Northerne signe, I adde vnto 90. degrees, the summe is 105. degrees 4′. which being deuided by 15. the quotient is 7. houres 0′. the halfe length of the day which being doubled will be 14. houres the whole length of the artificiall day in the Latitude of 52. degrees.

10 To finde the houre of the Sunne his rising or setting in any Latitude assigned.

FIrst find out the halfe length of the artificiall day by the 9. proposition, and subtract the same from 12. houres, the remainder will

will shew the houre of the sunnes rising, for example the Sun being in the beginning of Taurus to know the houre of his rising in the Latitude of 52. degrées, by the ninth proposition, the halfe length of the artificiall day I finde to bee 7. houres, which I subtract from 12. houres the remainder is 5. which sheweth that the Sun riseth at 5. of the clocke in the Morning, but the halfe length of the day it selfe is the houre of the Sunnes setting.

11 To find out the length of the planetarie houres and to find what Planet raigneth at any houre of the day.

FIrst find out the length of the artificiall day by the ninth proposition, and diuide the same by 12. the quotient is the length of one planetarie houre: or thus, hauing an houre of the artificial day giuen, loke what houre the same is from the Sunne rysing, and multiply the same by 12. diuide the product by the length of the artificiall day, the quotient is the number of the Planetarie houre. For example the sunne being in the beginning of Taurus, and our Latitude being 52. degrées, the length of the artificiall day by the ninth proposition is 14. houres: then doe I deuide 14 by 12. the quotient is $1\frac{1}{6}$. that is 1. houre 10. the length of one Planetarie houre. But if an houre of the artificiall day be giuen as that I would know what Planetarie houre it is at 9. of the clocke the Sunne being in the first of Taurus in the Latitude of 52. degrées, hauing found that the Sunne riseth at fiue of the clocke by the tenth proposition, I see that 4. houres of the artificiall day are gone at nine of the clocke, I therefore multiply 12. by 4. the product is 48. which I diuide by 14. the length of the artificiall day, the quotient is $3\frac{3}{7}$. which is the Planetarie houre at the time set downe: likewise shall you find the Planetarie houre of the night, finding the length thereof, and then worke with it as was shewed before for the day.

Now to know what Planet raigneth at any houre of the day or night is plainely set downe in the 52. Chapter which is the last Chapter of my second booke of the Spheare.

12 To

12 To finde the arch of the Equinoctiall, comprehended betwixt the Meridian and any Circle of position according vnto Campanus and Gazula.

MUltiply the Sine of the complement of your Latitude by the Tangent of the distance of the giuen Circle of position from the Zenith, & diuide the product by the totall Sine, the quotient is the Tangent of the arch of the Equinoctial, which is comprehended betwixt the giuen Circle of position, and the Meridian. For example in the Latitude of 52. I would knowe what part of the Equinoctiall is comprehended betwixt the Meridian and that Circle of position, which is 30. degrées from the Zenith: the Latitude being 52. degrées, the complement thereof is 38. degrées, the Sine whereof is 6156615. and the Tangent of 30. degrées, (for that 30. is the distance betwixt the giuen Circle of position and the Zenith) is 5773502. which being multiplyed by 6156615. the product is 35545229015730. which being diuided by 10000000. the totall Sine, the quotient is 3554522. for which I seeke among the Tangents, and I finde the Arke aunswering thereunto, to be 19. degrées 34. the Arch of the Equinoctiall, betwixt the Meridian and the giuen Circle of position.

13 Knowing the Latitude of your Region, and also the Eleuation of the Pole aboue any Circle of position, how to finde the inclination of the said Circle of position vnto the Meridian, and so consequently the Arch of the Equinoctiall, which is betwixt the said Circle of position and the Meridian.

MUltiply the Secant of the complement of the eleuation of the Pole aboue the Circle of position by the Sine of your Latitude, and diuide the product by the total Sine, the quotient is the Secant of the complement of the inclination of the circle of position vnto the Meridian, and that is the distance betwixt the Circle of Position and the Zenith, by helpe whereof you shall find the Arch of the Equinoctiall, betwixt the Circle of Position and the Meridian, as in the former proposition. As for example, suppose the eleuation of the Pole aboue the Circle of position, in our Latitude of 52. to be 23. degrées 1/2. Now to find out the Inclination

of

of that Circle of Position vnto the Meridian, first I multiply 25384445. the Secant of 66. degrees 4′8. (for that is the complement of 23. degrees 1′2. the eleuation of the Pole aboue the Circle of position) by 7880108 the Sine of 52. the Latitude of our Region, the product is 200032168120060. which being diuided by 10000000. the quotient is 20003216. for which I looke in the Table of Secants, and the Arch thereof is 60. degrees 0′. the complement whereof is 30. degrees 0′. which is the Inclination of the Circle of position vnto the Meridian, or the distance of the Zenith from the said Circle, then to finde the Arch of the Equinoctiall betwixt the said Circle of Position and the Meridian, repeate the worke of the former proposition.

14 To find out the Eleuation of the Pole aboue any assigned Circle of Position in any giuen Latitude.

KNowing the Inclination of the assigned Circle of Position vnto the Meridian, Multiply the Secant of the complement thereof by the totall Sine, and diuide the product by the Sine of your Latitude, the quotient is the Secant of the complement of the Eleuation of the Pole aboue the giuen Circle of Position: as for example, suppose the inclination of a Circle of position to bee 30. degrees 0′. Now to finde the eleuation of the Pole aboue the same for the Latitude of 52. degrees 0′. First take the complement of 30. degrees 0′. which is 60. degrees 0′. the Secant whereof is 20000000. which being multiplyed by the totall Sine the product is 200000000000000. which being diuided by 7880108. the Sine of 52. the assigned Latitude the quotient is 25 80362. for which I seeke in the Table of Secants, and the Arch answering thereunto I find to be 66. degrees 4′8. the complement whereof is, 23. degrees 1′2. and so much is the Eleuation of the Pole aboue the assigned Circle of Position in your Latitude.

Thus much touching the vse of the Tables of Sines, Tangents and Secants, now here followeth the three Tables, first the Table of Sines, secondly the Table of Tangents, and thirdly the Table of Secants.

FINIS.

HERE FOL-LOWETH THE TABLE OF RIGHT SINES FOR EVERIE MINVTE OF THE QVADRANT, FIRST CALCV-LATED BY *I. REGIO MONTANVS*, BVT NOW EXAMINED AND IN MANY PLACES COR-RECTED AND AMEN-DED BY *CLAVIVS*.

The Table of Sines.

The degrees of the Quadrant for the right Sines

	0	1	2	3	4	
0	0000	174524	348995	523360	697565	60
1	2909	177433	351902	526265	700467	59
2	5818	180341	354809	529170	703369	58
3	8727	183250	357716	532075	706270	57
4	11636	186158	360623	534980	709172	56
5	14544	189066	363530	537884	712073	55
6	17453	191975	366437	540789	714975	54
7	20362	194883	369344	543694	717876	53
8	23271	197792	372251	546598	720777	52
9	26180	200700	375158	549503	723678	51
10	29088	203608	378064	552407	726579	50
11	31997	206517	380971	555312	729480	49
12	34906	209425	383878	558216	732381	48
13	37815	212333	386785	561120	735282	47
14	40724	215241	389692	564024	738183	46
15	43632	218149	392598	566928	741084	45
16	46541	221057	395505	569832	743985	44
17	49450	223965	398412	572736	746886	43
18	52359	226873	401318	575640	749787	42
19	55268	229781	404225	578544	752688	41
20	58177	232689	407131	581448	755588	40
21	61086	235597	410038	584352	758489	39
22	63995	238505	412944	587256	761389	38
23	66904	241413	415851	590160	764290	37
24	69813	244321	418757	593064	767190	36
25	72721	247229	421663	595967	770090	35
26	75630	250137	424570	598871	772991	34
27	78539	253045	427476	601775	775891	33
28	81448	255953	430382	604678	778791	32
29	84357	258861	433288	607582	781691	31
30	87265	261769	436194	610485	784591	30
	89	88	87	86	85	

The minutes of the degrees of the Quadrant for the right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the right Sines of the cõplements of the Arches of the same Quadrat.

The degrees of the Quadrant for the right Sines

The Table of Sines.

of the Arches of the same Quadrant.

	0	1	2	3	4	
30	87265	261769	436194	610485	784591	30
31	90174	264677	439100	613389	787491	29
32	93083	267585	442006	616292	790391	28
33	95992	270493	444912	619196	793291	27
34	98901	273401	447818	622099	796191	26
35	101809	276308	450724	625002	799090	25
36	104718	279216	453630	627905	801990	24
37	107627	282124	456536	630808	804889	23
38	110536	285032	459442	633711	807789	22
39	113445	287940	462348	636614	810688	21
40	116353	290847	465253	639517	813587	20
41	119262	293755	468159	642420	816486	19
42	122171	296663	471065	645323	819385	18
43	125079	299570	473970	648226	822284	17
44	127988	302478	476876	651129	825183	16
45	130896	305385	479781	654032	828082	15
46	133805	308293	482687	656934	830981	14
47	136714	311200	485592	659837	833880	13
48	139622	314108	488498	662739	836778	12
49	142531	317015	491403	665642	839677	11
50	145439	319922	494308	668544	842576	10
51	148348	322830	497214	671447	845474	9
52	151257	325737	500119	674349	848372	8
53	154165	328645	503024	677251	851271	7
54	157074	331552	505929	680153	854169	6
55	159982	334459	508834	683055	857067	5
56	162891	337367	511740	685957	859965	4
57	165799	340274	514645	688859	862863	3
58	168708	343181	517550	691761	865761	2
59	171616	346088	520455	694663	868659	1
60	174524	348995	523360	697565	871557	0
	89	88	87	86	85	

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the complements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Sines.

The degrees of the Quadrant for the right Sines

The minutes of the degrees of the Quadrant for the right Sines of the Arches of the same Quadrant.

	5	6	7	8	9	
0	871557	1045285	1218693	1391731	1564345	60
1	874455	1048178	1221580	1394612	1567218	59
2	877353	1051071	1224467	1397492	1570091	58
3	880250	1053964	1227354	1400373	1572964	57
4	883148	1056857	1230241	1403253	1575837	56
5	886045	1059749	1233128	1406133	1578709	55
6	888943	1062642	1236015	1409013	1581581	54
7	891840	1065534	1238901	1411893	1584453	53
8	894737	1068426	1241788	1414772	1587325	52
9	897634	1071318	1244674	1417652	1590197	51
10	900531	1074210	1247560	1420531	1593069	50
11	903428	1077102	1250446	1423410	1595941	49
12	906325	1079994	1253332	1426289	1598812	48
13	909222	1082886	1256218	1429168	1601684	47
14	912119	1085778	1259104	1432047	1604555	46
15	915506	1088669	1261990	1434926	1607426	45
16	917913	1091561	1264876	1437805	1610297	44
17	920809	1094452	1267761	1440684	1613168	43
18	923706	1097344	1270647	1443562	1616038	42
19	926602	1100235	1273532	1446441	1618909	41
20	929498	1103126	1276417	1449319	1621779	40
21	932395	1106017	1279302	1452197	1624649	39
22	935291	1108908	1282187	1455075	1627519	38
23	938187	1111799	1285072	1457953	1630389	37
24	941083	1114690	1287957	1460831	1633259	36
25	943979	1117580	1290841	1463708	1636129	35
26	946875	1120471	1293726	1466586	1638999	34
27	949771	1123361	1296610	1469463	1641868	33
28	952667	1126252	1299495	1472340	1644738	32
29	955563	1129142	1302378	1475217	1647607	31
30	958458	1132032	1305262	1478094	1650476	30
	84	83	82	81	80	

The degrees of the Quadrant for the right Sines

of the Arches of the same Quadrant.

	5	6	7	8	9	
30	958458	1132032	1305262	1478094	1650476	30
31	961354	1134922	1308146	1480971	1653345	29
32	964249	1137812	1311030	1483848	1656214	28
33	967144	1140702	1313914	1486724	1659082	27
34	970039	1143592	1316798	1489601	1661951	26
35	972934	1146482	1319681	1492477	1664819	25
36	975829	1149372	1322564	1495353	1667687	24
37	978724	1152261	1325447	1498229	1670555	23
38	981619	1155151	1328330	1501105	1673423	22
39	984514	1158040	1331213	1503981	1676291	21
40	987408	1160929	1334096	1506857	1679159	20
41	990303	1163818	1336979	1509733	1682027	19
42	993198	1166707	1339862	1512608	1684894	18
43	996092	1169596	1342744	1515484	1687761	17
44	998987	1172485	1345627	1518359	1690628	16
45	1001881	1177374	1348509	1521234	1693495	15
46	1004775	1178263	1351392	1524109	1696362	14
47	1007669	1181151	1354274	1526984	1699229	13
48	1010563	1184040	1357156	1529859	1702095	12
49	1013457	1186928	1360038	1532734	1704962	11
50	1016351	1189816	1362920	1535608	1707828	10
51	1019245	1192704	1365802	1538482	1710694	9
52	1022139	1195592	1368683	1541356	1713560	8
53	1025032	1198480	1371564	1544230	1716426	7
54	1027926	1201368	1374446	1547104	1719292	6
55	1030819	1204255	1377327	1549978	1722157	5
56	1033713	1207143	1380208	1552852	1725022	4
57	1036606	1210031	1383089	1555725	1727887	3
58	1039499	1212918	1385970	1558599	1730752	2
59	1042392	1215806	1388851	1561472	1733617	1
60	1045285	1218693	1391731	1564345	1736482	0
	84	83	82	81	80	

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the complements of the Arches of the same Quadrat.

of the complements of the Arches of the same Quadrant.

The Table of Sines.

The degrees of the Quadrant for right Sines

	10	11	12	13	14	
0	1736482	1908090	2079117	2249511	2419219	60
1	1739347	1910945	2081962	2252345	2422041	59
2	1742211	1913800	2084807	2255179	2424863	58
3	1745075	1916655	2087652	2258013	2427685	57
4	1747939	1919510	2090497	2260847	2430507	56
5	1750803	1922365	2093342	2263680	2433329	55
6	1753667	1925220	2096186	2266513	2436150	54
7	1756531	1928074	2099030	2269346	2438971	53
8	1759394	1920928	2101874	2272179	2441792	52
9	1762258	1933782	2104718	2275012	2444613	51
10	1765121	1936636	2107562	2277844	2447434	50
11	1767984	1939490	2110405	2280676	2450254	49
12	1770847	1942344	2113248	2283508	2453074	48
13	1773710	1945197	2116091	2286340	2455894	47
14	1776573	1948050	2118934	2289174	2458714	46
15	1779435	1950903	2121777	2292004	2461533	45
16	1782298	1953756	2124620	2294835	2464352	44
17	1785160	1956609	2127462	2297666	2467171	43
18	1788022	1959462	2130304	2300497	2469990	42
19	1790884	1962314	2133146	2303328	2472809	41
20	1793746	1965166	2135988	2306159	2475628	40
21	1796608	1968018	2138830	2308989	2478446	39
22	1799469	1970870	2141671	2311819	2481264	38
23	1802331	1973722	2144512	2314649	2484082	37
24	1805192	1976574	2147353	2317479	2486900	36
25	1808053	1979425	2150194	2320309	2489717	35
26	1810914	1982276	2153035	2323138	2492534	34
27	1813774	1985127	2155876	2325967	2495351	33
28	1816634	1987978	2158716	2328796	2498168	32
29	1819495	1990829	2161556	2331625	2500984	31
30	1822355	1993679	2164396	2334454	2503800	30
	79	78	77	76	75	

The degrees of the Quadrant for right Sines

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the cõplements of the Arches of the same Quadrant.

of the Arches of the same Quadrant.

	10	11	12	13	14	
30	1822355	1993679	2164396	2334454	2503800	30
31	1825215	1996530	2167236	2337282	2506616	29
32	1828075	1999380	2170076	2340110	2509432	28
33	1830935	2002230	2172916	2342938	2512248	27
34	1833795	2005080	2175755	2345766	2515064	26
35	1836654	2007930	2178594	2348594	2517879	25
36	1839513	2010780	2181433	2351421	2520694	24
37	1842372	2013629	2184272	2354248	2523509	23
38	1845231	2016478	2187111	2357075	2526324	22
39	1848090	2019327	2189949	2359902	2529138	21
40	1850949	2022176	2192787	2362729	2531952	20
41	1853808	2025025	2195625	2365555	2534766	19
42	1856666	2027874	2198463	2368381	2537580	18
43	1859524	2030722	2201300	2371207	2540393	17
44	1862382	2033570	2204137	2374033	2543206	16
45	1865240	2036418	2206974	2376859	2546019	15
46	1868098	2039266	2209811	2379684	2548832	14
47	1870956	2042114	2212648	2382509	2551645	13
48	1873813	2044962	2215485	2385334	2554458	12
49	1876670	2047809	2218322	2388159	2557270	11
50	1879527	2050656	2221158	2390983	2560082	10
51	1882384	2053503	2223994	2393808	2562894	9
52	1885241	2056350	2226830	2396632	2565706	8
53	1888098	2059197	2229666	2399456	2568517	7
54	1890954	2062043	2232502	2402280	2571328	6
55	1893810	2064889	2235337	2405104	2574139	5
56	1896666	2067735	2238172	2407927	2576950	4
57	1899522	2070581	2241007	2410750	2579760	3
58	1902378	2073427	2243842	2413573	2582570	2
59	1905234	2076272	2246677	2416396	2585380	1
60	1908090	2079117	2249511	2419219	2588190	0
	79	78	77	79	75	

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes or degrees of the Quadrant for right Sines of the complements of the Arches of the same Quadrat.

of the complements of the Arches of the same Quadrant.

The Table of Sines.

The degrees of the Quadrant for right Sines

	15	16	17	18	19	
0	2588190	2756373	2923717	3090170	3255682	60
1	2591000	2759169	2926499	3092936	3258532	59
2	2593809	2761965	2929280	3095702	3261182	58
3	2596618	2764761	2932061	3098468	3263931	57
4	2599427	2767556	2934842	3101234	3266681	56
5	2602236	2770351	2937623	3103999	3269430	55
6	2605045	2773146	2940403	3106764	3272179	54
7	2607853	2775941	2943183	3109529	3274927	53
8	2610661	2778735	2945963	3112294	3277675	52
9	2613469	2781529	2948743	3115058	3280423	51
10	2616277	2784323	2951523	3117822	3283171	50
11	2619084	2787117	2954302	3120586	3285918	49
12	2621891	2789911	2957081	3123349	3288665	48
13	2624698	2792704	2959860	3126112	3291412	47
14	2627505	2795497	2962638	3128875	3294159	46
15	2630312	2798290	2965416	3131638	3296906	45
16	2633118	2801082	2968194	3134400	3299652	44
17	2635924	2803874	2970972	3137162	3302398	43
18	2638730	2806666	2973750	3139924	3305144	42
19	2641536	2809458	2976527	3141686	3307889	41
20	2644342	2812250	2979304	3145448	3310634	40
21	2647147	2815041	2982081	3148209	3313379	39
22	2649952	2817823	2984857	3150970	3316123	38
23	2652757	2820623	2987633	3153731	3318867	37
24	2655562	2823414	2990409	3156491	3321611	36
25	2658366	2826204	2993185	3159251	3324355	35
26	2661170	2828994	2995960	3162011	3327098	34
27	2663974	2831784	2998735	3164770	3329841	33
28	2666777	2834574	3001510	3167529	3332585	32
29	2669580	2837364	3004284	3170288	3335327	31
30	2672383	2840153	3007058	3173047	3338069	30
	74	73	72	71	70	

The degrees of the Quadrant for right Sines

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the cõplements of the Arches of the same Quadrant.

of the Arches of the same Quadrant.

	15	16	17	18	19	
30	2672383	2840153	3007058	3173047	3338069	30
31	2675186	2842942	3009832	3175805	3340811	29
32	2677989	2845731	3012606	3178563	3343553	28
33	2680792	2848520	3015380	3181321	3346294	27
34	2683595	2851308	3018153	3184079	3349035	26
35	2686397	2854096	3020926	3186837	3351776	25
36	2689199	2856884	3023699	3189594	3354516	24
37	2692001	2859672	3026472	3192351	3357256	23
38	2694802	2862459	3029244	3195108	3359996	22
39	2697603	2865246	3032016	3197864	3362736	21
40	2700404	2868033	3034788	3200620	3365475	20
41	2703205	2870819	3037559	3203375	3368214	19
42	2706005	2873605	3040330	3206130	3370953	18
43	2708805	2876391	3043101	3208885	3373691	17
44	2711605	2879177	3045872	3211640	3376429	16
45	2714405	2881963	3048643	3214395	3379167	15
46	2717204	2884748	3051413	3217150	3381905	14
47	2720003	2887533	3054183	3219904	3384642	13
48	2722802	2890318	3056953	3222658	3387379	12
49	2725601	2893103	3059723	3225412	3390116	11
50	2728400	2895888	3062492	3228165	3392852	10
51	2731198	2898672	3065261	3230918	3395588	9
52	2733996	2901456	3068030	3233671	3398324	8
53	2736794	2904240	3070798	3236423	3401060	7
54	2739592	2907023	3073566	3239175	3403795	6
55	2742389	2909806	3076334	3241927	3406530	5
56	2745186	2912589	3079102	3244679	3409265	4
57	2747983	2915371	3081869	3247430	3411999	3
58	2750780	2918153	3084636	3250181	3414733	2
59	2753577	2920935	3087403	3252932	3417467	1
60	2756373	2923717	3090170	3255682	3420201	0
	74	73	72	71	70	

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the complements of the Arches of the same Quadrant.

of the complements of the Arches of the same Quadrant.

The Table of Sines.

The degrees of the Quadrant for right Sines

	20	21	22	23	24	
0	3420201	3583679	3746066	3907311	4067366	60
1	3422934	3586395	3748763	3909989	4070023	59
2	3425667	3589110	3751460	3912666	4072680	58
3	3428400	3591825	3754156	3915343	4075337	57
4	3431133	3594540	3756852	3918020	4077993	56
5	3433865	3597254	3759548	3920696	4080649	55
6	3436597	3599968	3762243	3923372	4083305	54
7	3439329	3602682	3764938	3926048	4085960	53
8	3442060	3605395	3767633	3928723	4088615	52
9	3444791	3608108	3770327	3921398	4091269	51
10	3447522	3610821	3773021	3934072	4093923	50
11	3450253	3613533	3775715	3936746	4096577	49
12	3452983	3616245	3778408	3939420	4099231	48
13	3455713	3618957	3781101	3942093	4101884	47
14	3458442	3621669	3783794	3944766	4104537	46
15	3461171	3624380	3786486	3947439	4107189	45
16	3463900	3627091	3789178	3950112	4109841	44
17	3466629	3629802	3791870	3952784	4112493	43
18	3469357	3632512	3794562	3955456	4115144	42
19	3472085	3635222	3797253	3958128	4117795	41
20	3474813	3637932	3799944	3960799	4120446	40
21	3477540	3640642	3802635	3963470	4123096	39
22	3480267	3643351	3805325	3966140	4125746	38
23	3482994	3646060	3808015	3968810	4128395	37
24	3485721	3648768	3810704	3971480	4131044	36
25	3488447	3651476	3813393	3974149	4133693	35
26	3491173	3654184	3816082	3976818	4136341	34
27	3493899	3656892	3818771	3979487	4138989	33
28	3496624	3659599	3821459	3982155	4141637	32
29	3499349	3662306	3824147	3984823	4144285	31
30	3502075	3665012	3826834	3987491	4146932	30
	69	68	67	66	65	

The degrees of the Quadrant for right Sines

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the cõplements of the Arches of the same Quadrant.

of the Arches of the same Quadrant.

	20	21	22	23	24	
30	3502075	3665012	3826834	3987491	4146932	30
31	3504799	3667718	3829521	3990159	4149579	29
32	3507523	3670424	3832208	3992826	4152226	28
33	3510247	3673130	3834895	3995493	4154872	27
34	3512971	3675835	3837581	3998159	4157518	26
35	3515694	3678541	3840267	4000825	4160163	25
36	3518417	3681246	3842953	4003491	4162808	24
37	3521140	3683951	3845638	4006156	4165453	23
38	3523862	3686655	3848323	4008821	4168097	22
39	3526584	3689359	3851008	4011486	4170741	21
40	3529306	3692062	3853692	4014150	4173385	20
41	3532027	3694765	3856376	4016814	4176028	19
42	3534748	3697468	3859060	4019478	4178671	18
43	3537469	3700170	3861743	4022141	4181313	17
44	3540190	3702872	3864426	4024804	4183955	16
45	3542910	3705574	3867109	4027467	4186597	15
46	3545630	3708276	3869791	4030130	4189239	14
47	3548350	3710977	3872473	4032792	4191880	13
48	3551070	3713678	3875155	4035454	4194521	12
49	3553789	3716379	3877837	4038115	4197162	11
50	3556508	3719080	3880518	4040776	4199802	10
51	3559227	3721780	3883199	4043437	4202442	9
52	3561945	3724480	3885880	4046097	4205081	8
53	3564663	3727179	3888560	4048757	4207720	7
54	3567380	3729878	3891240	4051416	4210359	6
55	3570097	3732577	3893919	4054075	4212997	5
56	3572814	3735275	3896598	4056734	4215635	4
57	3575531	3737973	3899277	4059392	4218273	3
58	3578247	3740671	3901955	4062050	4220910	2
59	3580963	3743369	3904633	4064708	4223547	1
60	3583679	3746066	3907311	4067366	4226183	0
	69	68	67	66	65	

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the complements of the Arches of the same Quadrant.

of the complements of the Arches of the same Quadrant.

The Table of Sines.

The degrees of the Quadrant for right Sines

	25	26	27	28	29	
0	4226183	4383712	4539905	4694716	4848096	60
1	4228819	4386326	4542497	4697284	4850640	59
2	4231455	4388940	4545088	4699852	4853184	58
3	4234090	4391554	4547679	4702419	4855727	57
4	4236725	4394167	4550270	4704986	4858270	56
5	4239360	4396780	4552860	4707553	4860812	55
6	4241994	4399392	4555450	4710119	4863354	54
7	4244628	4402004	4558039	4712685	4865895	53
8	4247262	4404616	4560628	4715250	4868436	52
9	4249895	4407227	4563216	4717815	4860977	51
10	4252528	4409838	4565804	4720380	4873517	50
11	4255161	4412449	4568392	4722944	4876057	49
12	4257793	4415059	4570979	4725508	4878596	48
13	4260425	4417669	4573566	4728071	4881135	47
14	4263056	4420279	4576153	4730634	4883674	46
15	4265687	4422887	4578739	4733197	4886212	45
16	4268318	4425496	4581325	4735759	4888750	44
17	4270949	4428104	4583911	4738321	4891287	43
18	4273579	4430712	4586496	4740882	4893824	42
19	4276209	4433320	4589081	4743443	4896361	41
20	4278838	4435927	4591665	4746004	4898897	40
21	4281467	4438534	4594249	4748564	4901433	39
22	4284096	4441140	4596833	4751124	4903968	38
23	4286724	4443746	4599416	4753683	4906503	37
24	4289352	4446352	4601999	4756242	4909037	36
25	4291979	4448957	4604581	4758801	4911571	35
26	4294606	4451562	4607163	4761359	4914105	34
27	4297233	4454167	4609744	4763917	4916638	33
28	4299859	4456771	4612325	4766474	4919171	32
29	4302485	4459375	4614906	4769031	4921703	31
30	4305111	4461978	4617486	4771588	4924235	30
	64	63	62	61	60	

The degrees of the Quadrant for right Sines

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the cõplements of the Arches of the same Quadrant.

of the Arches of the same Quadrant.

	25	26	27	28	29	
30	4305111	4461978	4617486	4771588	4924235	30
31	4307736	4464581	4620066	4774144	4926767	29
32	4310361	4467184	4622646	4776700	4929298	28
33	4312986	4469786	4625225	4779255	4931829	27
34	4315610	4472388	4627804	4781810	4934359	26
35	4318234	4474990	4630382	4784365	4936889	25
36	4320858	4477591	4632960	4786919	4939418	24
37	4323481	4480192	4635538	4789473	4941947	23
38	4326104	4482792	4638115	4792026	4944476	22
39	4328726	4485392	4640692	4794579	4947004	21
40	4331348	4487992	4643268	4797132	4949532	20
41	4333970	4490591	4645844	4799684	4952059	19
42	4336591	4493190	4648420	4802236	4954586	18
43	4339212	4495788	4650995	4804787	4957113	17
44	4341833	4498380	4653570	4807338	4959639	16
45	4344453	4500984	4656145	4809888	4962165	15
46	4347073	4503582	4658719	4812438	4964690	14
47	4349693	4506179	4661293	4814988	4967215	13
48	4352312	4508776	4663866	4817537	4969740	12
49	4354931	4511372	4666439	4820086	4972264	11
50	4357549	4513968	4669012	4822635	4974788	10
51	4360167	4516563	4671584	4825183	4977311	9
52	4362785	4519158	4674156	4827731	4979834	8
53	4365402	4521753	4676727	4830278	4982356	7
54	4368019	4524347	4679298	4832825	4984878	6
55	4370635	4526941	4681869	4835371	4987399	5
56	4373251	4529535	4684439	4837917	4989920	4
57	4375867	4532128	4687009	4840462	4992441	3
58	4378482	4534721	4689578	4843007	4994961	2
59	4381097	4537313	4692147	4845552	4997481	1
60	4383712	4539905	4694716	4848096	5000000	0
	64	63	62	61	60	

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the complements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Sines.

The degrees of the Quadrant for the right Sines

	20	31	32	33	34	
0	5000000	5150381	5299192	5446390	5591929	60
1	5002519	5152874	5301659	5448829	5594340	59
2	5005038	5155367	5304125	5451268	5596751	58
3	5007556	5157859	5306591	5453707	5599161	57
4	5010074	5160351	5309056	5456145	5601571	56
5	5012591	5162843	5311521	5458585	5603981	55
6	5015108	5165334	5313985	5461020	5606390	54
7	5017624	5167825	5316449	5463456	5608798	53
8	5020140	5170315	5318913	5465892	5611206	52
9	5022656	5172805	5321376	5468328	5613614	51
10	5025171	5175294	5323839	5470763	5616021	50
11	5027686	5177783	5326301	5473198	5618427	49
12	5030200	5180271	5328763	5475632	5620833	48
13	5032714	5182759	5331224	5478066	5623239	47
14	5035227	5185246	5333685	5480499	5625644	46
15	5037740	5187733	5336145	5482932	5628049	45
16	5040253	5190220	5338605	5485364	5630453	44
17	5042765	5192706	5341065	5487796	5632857	43
18	5045277	5195192	5343524	5490228	5635260	42
19	5047788	5197677	5345983	5492659	5637663	41
20	5050299	5200162	5348441	5495096	5640066	40
21	5052809	5202646	5350898	5497520	5642468	39
22	5055319	5205130	5353355	5499950	5644869	38
23	5057829	5207614	5355812	5502379	5647270	37
24	5060338	5210097	5358268	5504808	5649670	36
25	5062847	5212580	5360724	5507236	5652070	35
26	5065355	5215062	5363179	5509664	5654469	34
27	5067863	5217544	5365634	5512091	5656868	33
28	5070370	5220025	5368088	5514518	5659266	32
29	5072877	5222506	5370542	5516944	5661664	31
30	5075384	5224986	5372996	5519370	5664062	30
	59	58	57	56	55	

The degrees of the Quadrant for the right Sines

The minutes of the degrees of the Quadrant for the right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the right Sines fo the cõplements of the Arches of the same Quadrat.

of the Arches of the same Quadrant.

	30	31	32	33	34	
30	5075384	5224986	5372996	5519370	5664062	30
31	5077890	5227466	5375449	5521795	5666459	29
32	5080396	5229949	5377902	5524220	5668856	28
33	5082901	5232425	5380354	5526645	5671252	27
34	5085406	5234904	5382806	5529069	5673648	26
35	5087911	5237382	5385258	5531493	5676043	25
36	5090415	5239860	5387709	5533916	5678438	24
37	5092619	5242337	5390159	5536338	5680832	23
38	5095422	5244814	5392609	5538760	5683226	22
39	5097925	5247290	5395058	5541182	5685619	21
40	5100427	5249766	5397507	5543603	5688012	20
41	5102929	5252241	5399955	5546024	5690404	19
42	5105430	5254716	5402403	5548444	5692796	18
43	5107931	5257191	5404851	5550864	5695187	17
44	5110431	5259665	5407298	5553283	5697578	16
45	5112931	5262139	5409745	5555702	5699968	15
46	5115431	5264612	5412191	5558110	5702358	14
47	5117930	5267085	5414637	5560538	5704747	13
48	5120429	5269557	5417082	5562956	5707136	12
49	5122927	5272029	5419527	5565373	5709524	11
50	5125425	5274501	5421972	5567790	5711912	10
51	5127922	5276972	5424416	5570206	5714299	9
52	5130419	5279443	5426859	5572622	5716686	8
53	5132916	5281913	5429302	5575037	5719072	7
54	5135412	5284383	5431747	5577452	5721458	6
55	5137908	5286852	5434187	5579866	5723844	5
56	5140403	5289321	5436620	5582280	5726229	4
57	5142898	5291789	5439070	5584693	5728613	3
58	5145393	5294257	5441510	5587106	5730997	2
59	5147887	5296725	5443950	5589518	5733381	1
60	5150381	5299192	5446390	55919 9	5735764	0
	59	58	57	56	55	

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the complements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Sines.

The degrees of the Quadrant for the right Sines

The minutes of the degrees of the Quadrant for the right Sines of the Arches of the same Quadrant.

	35	36	37	38	39	
0	5735764	5877852	6018150	6156615	6293204	60
1	5738147	5880205	6020470	6158907	6295464	59
2	5740529	5882558	6022796	6161198	6297724	58
3	5742911	5884910	6025118	6163489	6299983	57
4	5745294	5887262	6027439	6165780	6302242	56
5	5747672	5889613	6029760	6168070	6304501	55
6	5750052	5891964	6032080	6170359	6306759	54
7	5752432	5894315	6034400	6172648	6309016	53
8	5754811	5896664	6036719	6174936	6311273	52
9	5757190	5899013	6039038	6177224	6313529	51
10	5759568	5901361	6041357	6179512	6315784	50
11	5761946	5903709	6043675	6181799	6318039	49
12	5764323	5906056	6045992	6184085	6320293	48
13	5766700	5908403	6048309	6186371	6322547	47
14	5769076	5910750	6050625	6188656	6324800	46
15	5771452	5913096	6052940	6190940	6327053	45
16	5773827	5915442	6055255	6193224	6329305	44
17	5776202	5917787	6057570	6195508	6331557	43
18	5778576	5920132	6059884	6197791	6333808	42
19	5780950	5922476	6062198	6200074	6336059	41
20	5783324	5924820	6064511	6202356	6338310	40
21	5785697	5927165	6066824	6204638	6340560	39
22	5788069	5929505	6069136	6206919	6342809	38
23	5790441	5931847	6071448	6209199	6345058	37
24	5792812	5934189	6073759	6211479	6347306	36
25	5795183	5936530	6076069	6213758	6349553	35
26	5797553	5938871	6078379	6216037	6351800	34
27	5799923	5941211	6080688	6218315	6354046	33
28	5802292	5943551	6082997	6220593	6356292	32
29	5804661	5945890	6085306	6222870	6358537	31
30	5807030	5948228	6087614	6225146	6360782	30
	54	53	52	51	50	

The minutes of degrees of the Quadrant for the right Sines to the cõplements of the Arches of the same Quadrat.

The degrees of the Quadrant for the right Sines

The Table of Sines.

of the Arches of the same Quadrant.

	35	36	37	38	39	
30	5807030	5948228	6087614	6225146	6360782	30
31	5809398	5950566	6089922	6227422	6363026	29
32	5811766	5952904	6092229	6229698	6365270	28
33	5814133	5955241	6094536	6231973	6367513	27
34	5816499	5957578	6096842	6234248	6369756	26
35	5818865	5959914	6099147	6236522	6371999	25
36	5821230	5962250	6101452	6238796	6374241	24
37	5823595	5964585	6103756	6241069	6376482	23
38	5825959	5966919	6106060	6243342	6378722	22
39	5828323	5969253	6108364	6245614	6380962	21
40	5830687	5971586	6110667	6247885	6383201	20
41	5833050	5973919	6112970	6250156	6385440	19
42	5835412	5976251	6115272	6252426	6387678	18
43	5837774	5978583	6117573	6254696	6389916	17
44	5840136	5980915	6119873	6256966	6392153	16
45	5842497	5983146	6122173	6259235	6394390	15
46	5844858	5985577	6124473	6261503	6396626	14
47	5847218	5987907	6126772	6263771	6398862	13
48	5849578	5990237	6129071	6266038	6401097	12
49	5851937	5992566	6131369	6268305	6403332	11
50	5854295	5994894	6133667	6270572	6405566	10
51	5856653	5997222	6135964	6272838	6407799	9
52	5859010	5999549	6138261	6275103	6410032	8
53	5861367	6001876	6140557	6277368	6412264	7
54	5863724	6004202	6142853	6279632	6414496	6
55	5866080	6006528	6145148	6281895	6416728	5
56	5868436	6008853	6147442	6284158	6418959	4
57	5870791	6011178	6149736	6286420	6421189	3
58	5873145	6013502	6152030	6288682	6423419	2
59	5875499	6015826	6154325	6290943	6425648	1
60	5877852	6018150	6156615	6293204	6427876	0
	54	53	52	51	50	

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the cõplements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Sines.

The degrees of the Quadrant for the right Sines

	40	41	42	43	44	
0	6427876	6560590	6691306	6819984	6946584	60
1	6430104	6562785	6693468	6822111	6948676	59
2	6432331	6564979	6695629	6824237	6950767	58
3	6434558	6567173	6697789	6826363	6952858	57
4	6436785	6569367	6699949	6828489	6954949	56
5	6439011	6571560	6702108	6830614	6957039	55
6	6441236	6573753	6704267	6832738	6959128	54
7	6443461	6575945	6706425	6834861	6961216	53
8	6445685	6578136	6708582	6836984	6963304	52
9	6447909	6580326	6710739	6839107	6965392	51
10	6450132	6582516	6712895	6841229	6967479	50
11	6452355	6584705	6715051	6843350	9969565	49
12	6454577	6586894	6717206	6845471	6971651	48
13	6456799	6589082	6719361	6847591	6973736	47
14	6459020	6591270	6721515	6849711	6975821	46
15	6461240	6593458	6723968	6851830	6977905	45
16	6463460	6595645	6725821	6853949	6979988	44
17	6465679	6597831	6727973	6856067	6982071	43
18	6467898	6600016	6730125	6858184	6984153	42
19	6470116	6602201	6732276	6860301	6986235	41
20	6472333	6604386	6734427	6862417	6988319	40
21	6474550	6606570	6736577	6864533	6990396	39
22	6476766	6608753	6738726	6866648	6992476	38
23	6478982	6610936	6740875	6868762	6994555	37
24	6481198	6613118	6743024	6870870	6996634	36
25	6483413	6615300	6745172	6872989	6998712	35
26	6485628	6617481	6747319	6875102	7000789	34
27	6487842	6619661	6749465	6877214	7002866	33
28	6490055	6621841	6751611	6879325	7004942	32
29	6492268	6624021	6753757	6881436	7007018	31
30	6494480	6626200	6755902	6883546	7009093	30
	48	48	47	46	45	

The minutes of the degrees of the Quadrant for the right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the right Sines of the coplements of the Arches of the same Quadrant.

The degrees of the Quadrant for the right Sines

of the Arches of the same Quadrant.

	40	41	42	43	44	
30	6494480	6626200	6755902	6883546	7009093	30
31	6496692	6628379	6758047	6885656	7011167	29
32	6498903	6630557	6760191	6887765	7013241	28
33	6501114	6632734	6762334	6889874	7015314	27
34	6503324	6634911	6764477	6891982	7017387	26
35	6505533	6637087	6766619	6894089	7019459	25
36	6507742	6639263	6768760	6896196	7021530	24
37	6509950	6641438	6770901	6898302	7023601	23
38	6512158	6643612	6773041	6900408	7025671	22
39	6514365	6645786	6775181	6902513	7027741	21
40	6516572	6647959	6777320	6904617	7029810	20
41	6518778	6650132	6779459	6906721	7031879	19
42	6520984	6652304	6781597	6908824	7033947	18
43	6523189	6654476	6783734	6910927	7036014	17
44	6525394	6656647	6785871	6913029	7038081	16
45	6527598	6658817	6788007	6915131	7040147	15
46	6529801	6660987	6790143	6917232	7042213	14
47	6532004	6663156	6792278	6919332	7044278	13
48	6534206	6665325	6794413	6921432	7046342	12
49	6536408	6667493	6796547	6923531	7048406	11
50	6538609	6669661	6798681	6925630	7050469	10
51	6540809	6671828	9800814	6927728	7052432	9
52	6543009	6673994	6802946	6929725	7054594	8
53	6545208	6676160	6805078	6931922	7056655	7
54	6547407	6678326	6807209	6934018	7058716	6
55	6549606	6680491	6809340	6936114	7060776	5
56	6551804	6682655	6811470	6938209	7062836	4
57	6554001	6684818	6813599	6940303	7064895	3
58	6556198	6686981	6815728	6942397	7066953	2
59	6558394	6689144	6817856	6944491	7069011	1
60	6560590	6691306	6819984	6946584	7071068	0
	49	48	47	46	45	

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the cõplements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Sines.

The degrees of the Quadrant for the right Sines

	45	46	47	48	49	
0	7071068	7193398	7313537	7431448	7547096	60
1	7073125	7195418	7315521	7433394	7549004	59
2	7075181	7197438	7317504	7435339	7550911	58
3	7077236	7199457	7319486	7437284	7552818	57
4	7079291	7201476	7321468	7439229	7554724	56
5	7081345	7203494	7323449	7441173	7550630	55
6	7083399	7205511	7325429	7443116	7558535	54
7	7085452	7207527	7327409	7445058	7560439	53
8	7087504	7209543	7329388	7447000	7562343	52
9	7089556	7211559	7331367	7448941	7564246	51
10	7091607	7213574	7333345	7450882	7566148	50
11	7093658	7215588	7335322	7452822	7568050	49
12	7095708	7217601	7337298	7454761	7569951	48
13	7097757	7219614	7339274	7456690	7571851	47
14	7099806	7221627	7341250	7458637	7573751	46
15	9101854	7223639	7343225	7460574	7575650	45
16	7103902	7225661	7345199	7462511	7577548	44
17	7105949	7227662	7347173	7464447	7579446	43
18	7107995	7229672	7349146	7466382	7581343	42
19	7110041	7231681	7351118	7568317	7583240	41
20	7112086	7233689	7353090	7470251	7585136	40
21	7114131	7235697	7355061	7472184	7587031	39
22	7116175	7237704	7357031	7474117	7588925	38
23	7118218	7139711	7359001	7476049	7590819	37
24	7120261	7241718	7360970	7477981	7592714	36
25	7122303	7243724	7362939	7479912	7594606	35
26	7124344	7245729	7364907	7481842	7596498	34
27	7126385	7247733	7366874	7483771	7598389	33
28	7128425	7249737	7368841	7485700	7600280	32
29	7130465	7251741	7370807	7487629	7602170	31
30	7132504	7253744	7372773	7489557	7604060	30
	44	43	42	41	40	

The minutes of the degrees of the Quadrant for the right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the right Sines of the coplements of the Arches of the same Quadrat.

The degrees of the Quadrant for the right Sines

of the Arches of the same Quadrant.

	45	46	47	48	49	
30	7132504	7253744	7372773	7489557	7604960	30
31	7134543	7255746	7374738	7491484	7605949	29
32	7136581	7257747	7376702	7493410	7607637	28
33	7138618	7259748	7378666	7495336	7609725	27
34	7140655	7261749	7380926	7497262	7611612	26
35	7142691	7263759	7382592	7499187	7613498	25
36	7144724	7265748	7384554	7501111	7615384	24
37	7146762	7267746	7386515	7503034	7617269	23
38	7148796	7269744	7388475	7504957	7619153	22
39	7150830	7271741	7390435	7506879	7621037	21
40	7152863	7273737	7392394	7508801	7622920	20
41	7154895	7275733	7394353	7510722	7624802	19
42	7156927	7277728	7396311	7512642	7626683	18
43	7158958	7279722	7398268	7514561	7628564	17
44	7160989	7281716	7400225	7516480	7630445	16
45	7163019	7283710	7402181	7518398	7632325	15
46	7165049	7285703	7404137	7520316	7634204	14
47	7167078	7287695	7406092	7522233	7636082	13
48	7169106	7289687	7408046	7524146	7637960	12
49	7171134	7291678	7410000	7526065	7639838	11
50	7173161	7293668	7411953	7527980	7641715	10
51	7175187	7295658	7413905	7529894	7643591	9
52	7177213	7297647	7415856	7531808	7645466	8
53	7179238	7299635	7417807	7533721	7647341	7
54	7181263	7301623	7419758	7535634	7649215	6
55	7183287	7303610	7421708	7537546	7651088	5
56	7185310	7305597	7423657	7539457	7652961	4
57	7187333	7307583	7425605	7541367	7654833	3
58	7189355	7309568	7427552	7543277	7656704	2
59	7191377	7311553	7429501	7545187	7658575	1
60	7193398	7313537	7431448	7547096	7660445	0
	44	43	42	41	40	

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the complements of the Arches of the same Quadrat.

of the complements of the Arches of the same Quadrant.

The Table of Sines.

The degrees of the Quadrant for right Sines

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

	50	51	52	53	54	
0	7660445	7771460	7880108	7986355	8090170	60
1	7662314	7773290	7881898	7988105	8091869	59
2	7664183	7775120	7883688	7989855	8093588	58
3	7666051	7776949	7885477	7991604	8095296	57
4	7667919	7778777	7887266	7993352	8097004	56
5	7669786	7780605	7889054	7995100	8098711	55
6	7671652	7782432	7890841	7996847	8100417	54
7	7673517	7784258	7892927	7998593	8102122	53
8	7675382	7786084	7894413	8000339	8103827	52
9	7677246	7787909	7896198	8002084	8105531	51
10	7679110	7789833	7897983	8003828	8107234	50
11	7680973	7791557	7899767	8005571	8108936	49
12	7682835	7793380	7901550	8007314	8110638	48
13	7684697	7795202	7903332	8009056	8112339	47
14	7686558	7797024	7905114	8010797	8114040	46
15	7688418	7798845	7906895	8012538	8115740	45
16	7690278	7800665	7908676	8014278	8117439	44
17	7692137	7802485	7910456	8016017	8119137	43
18	7693995	7804304	7912235	8017756	8120835	42
19	7695853	7806123	7914014	8019494	8122532	41
20	7697710	7807941	7915792	8021232	8124229	40
21	7699566	7809758	7917569	8022969	8125925	39
22	7701422	7811574	7919345	8024705	8127620	38
23	7703277	7813390	7921121	8026440	8129314	37
24	7705132	7815205	7922896	8028175	8131008	36
25	7706986	7817020	7924671	8029909	8132701	35
26	7708839	7818834	7926445	8021642	8134393	34
27	7710691	7820647	7928218	8033375	8136084	33
28	7712544	7822459	7929990	8035107	8137775	32
29	7714395	7824271	7931762	8036838	8139465	31
30	7716246	7826082	7933533	8038569	8141155	30
	39	38	37	36	35	

The minutes of degrees of the Quadrant for right Sines of the complements of the Arches of the same Quadrant.

The degrees of the Quadrant for right Sines

The Table of Sines.

of the Arches of the same Quadrant.

	50	51	52	53	54	
30	7716246	7826082	7933533	8038569	8141155	30
31	7718096	7827892	7935303	8040299	8142844	29
32	7719945	7829702	7937073	8042028	8144532	28
33	7721794	7831511	7938842	8043757	8146220	27
34	7723642	7833320	7940611	8045485	8147907	26
35	7725490	7835128	7942379	8047212	8149593	25
36	7727337	7836935	7944146	8048938	8151278	24
37	7729183	7838741	7945912	8050664	8152963	23
38	7731028	7840547	7947678	8052389	8154647	22
39	7732872	7842352	7949443	8054114	8156330	21
40	7734716	7844157	7951208	8055838	8158013	20
41	7736559	7845961	7952972	8057561	8159695	19
42	7738402	7847764	7954735	8059283	8161376	18
43	7740244	7849566	7956497	8061005	8163057	17
44	7742085	7851368	7958259	8062726	8164737	16
45	7743926	7853169	7960020	8064446	8166416	15
46	7745766	7854970	7961780	8066166	8168094	14
47	7747606	7856770	7963540	8067885	8169772	13
48	7749445	7858569	7965299	8069603	8171449	12
49	7751283	7860368	7967057	8071321	8173126	11
50	7753121	7862166	7968815	8073038	8174802	10
51	7754958	7863963	7970572	8074754	8176477	9
52	7756794	7865759	7972328	8076470	8178151	8
53	7758630	7867555	7974084	8078185	8179825	7
54	7760465	7869350	7975839	8079899	8181498	6
55	7762299	7871145	7977593	8081613	8183170	5
56	7764132	7872939	7979347	8083326	8184841	4
57	7765965	7874732	7981100	8085038	8186512	3
58	7767797	7876525	7982852	8086749	8188182	2
59	7769629	7878317	7984604	8088460	8189851	1
60	7771460	7880108	7986355	8090170	8191520	0
	29	28	27	26	25	

The minutes of degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the complements of the Arches of the same Quadrant.

The Table of Sines.

The degrees of the Quadrant for right Sines

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

	55	56	57	58	59	
0	8191520	8270376	8386706	8480481	8571673	60
1	8193188	8292002	8388290	8482022	8573171	59
2	8194855	8293628	8389873	8483562	8574668	58
3	8196522	8295253	8391456	8485102	8576164	57
4	8198188	8296877	8393038	8486641	8577660	56
5	8199854	8298501	8394619	8488180	8579155	55
6	8201519	8300124	8396199	8489718	8580649	54
7	8203183	8301746	8397778	8491255	8582142	53
8	8204846	8303367	8399357	8492791	8583635	52
9	8206508	8304987	8400935	8494326	8585127	51
10	8208170	8306607	8402513	8495860	8586619	50
11	8209831	8308226	8404090	8497394	8588110	49
12	8211491	8309844	8405666	8498927	8589600	48
13	8218151	8311462	8407241	8500459	8591089	47
14	8214810	8313079	8408816	8501991	8592577	46
15	8216469	8314696	8410390	8503522	8594064	45
16	8218127	8316312	8411963	8505052	8595551	44
17	8219784	8317927	8413536	8506582	8597037	43
18	8221440	8319541	8415108	8508111	8598523	42
19	8223096	8321155	8416679	8509639	8600008	41
20	8224751	8322768	8418250	8511167	8601492	40
21	8226405	8324380	8419810	8512694	8602975	39
22	8228058	8325991	8421389	8514220	8604457	38
23	8229711	8327602	8422957	8515745	8605939	37
24	8231363	8329212	8424525	8517270	8607420	36
25	8233015	8330822	8426092	8518794	8608901	35
26	8234666	8332431	8427658	8520317	8610381	34
27	8236316	8334039	8429223	8521839	8611860	33
28	8237965	8335646	8430788	8523361	8613338	32
29	8239614	8337252	8432352	8524882	8614815	31
30	8241262	8338858	8433915	8526402	8616292	30
	34	33	32	32	30	

The minutes of degrees of the Quadrant for right Sines of the complements of the Arches of the same Quadrant.

The degrees of the Quadrant for the Secants

of the Arches of the same Quadrant.

	55	56	57	58	59	
30	8241262	8338858	8433915	8526402	8616292	30
31	8252909	8340463	8435477	8527921	8617768	29
32	8244556	8342067	8437039	8529440	8619243	28
33	8246202	8343671	8438600	8530958	8620718	27
34	8247847	8345247	8440161	8532476	8622192	26
35	8249492	8346877	8441721	8533993	8623665	25
36	8251136	8348479	8443280	8535509	8625137	24
37	2528779	8350080	8444838	8537024	8626608	23
38	8254421	8351680	8446396	8538538	8628079	22
39	8256062	8353279	8447953	8540052	8629549	21
40	8257703	8354878	8449509	8541565	8631019	20
41	8259343	8356476	8451064	8543077	8632488	19
42	8260982	8358073	8452618	8544588	8633986	18
43	8262621	8359670	8454172	8546099	8635423	17
44	8264259	8361266	8455725	8547609	8636859	16
45	8265897	8362862	8457278	8549119	8638355	15
46	8267534	8364457	8458830	8550628	8639820	14
47	8269170	8366051	8460381	8552136	8641284	13
48	8270806	8367644	8461932	8553643	8642748	12
49	8272441	8369236	8463482	8555149	8644211	11
50	8274075	8370828	8465031	8556655	8645673	10
51	8275708	8372419	8466579	8558160	8647134	9
52	8277340	8374009	8468126	8559664	8648595	8
53	8278972	8375599	8469673	8561168	8650055	7
54	8280603	8377188	8471219	8562671	8651514	6
55	8282234	8378776	8472765	8564173	8652973	5
56	8283864	8380363	8474310	8565675	8654431	4
57	8285493	8381950	8475854	8567176	8655888	3
58	8287121	8383536	8477397	8568676	8657344	2
59	8288749	8385121	8478939	8570175	8658799	1
60	8290376	8386706	8480481	8571673	8660254	0
	34	33	32	31	30	

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the complements of the Arches of the same Quadrat.

of the complements of the Arches of the same Quadrant.

The Table of Sines.

The degrees of the Quadrant for the right Sines

	60	61	62	63	64	
0	8660254	8746197	8829476	8910065	8987940	60
1	8661708	8747607	8830841	8911385	8989215	59
2	8663162	8749016	8832205	8912704	8990489	58
3	8664615	8750425	8833569	8914023	8991762	57
4	8666067	8751833	8834932	8915341	8993035	56
5	8667517	8753240	8836295	8916659	8994307	55
6	8668968	8754646	8837657	8917976	8995578	54
7	8670417	8756051	8839018	8919292	8996848	53
8	8671866	8757456	8840378	8920607	8998117	52
9	8673314	8758860	8841737	8921921	8999386	51
10	8674762	8760263	8843095	8923234	9000654	50
11	8676209	8761665	8844452	8924546	9001921	49
12	8677655	8763067	8845809	8925858	9003187	48
13	8679100	8764468	8847165	8927169	9004453	47
14	8680544	8765868	8848521	8928479	9005718	46
15	8681988	8767268	8849876	8929789	9006982	45
16	8683431	8768667	8851230	8931098	9008245	44
17	8684874	8770065	8852583	8932406	9009508	43
18	8686316	8771462	8853936	8933714	9010770	42
19	8687757	8772859	8855288	8935021	9012031	41
20	8689197	8774255	8856639	8936327	9013292	40
21	8699636	8775650	8857989	8937632	9014552	39
22	8692074	8777044	8859338	8938936	9015811	38
23	8693512	8778437	8860687	8940240	9017069	37
24	8694949	8779830	8862035	8941543	9018326	36
25	8696386	8781222	8863383	8942845	9019582	35
26	8697822	8782613	8864730	8944146	9020838	34
27	8699257	8784003	8866076	8945446	9022093	33
28	8700691	8785393	8867421	8946746	9023347	32
29	8702124	8786782	8868765	8948045	9024600	31
30	8703557	8788171	8870108	8949344	9025853	30
	29	28	27	26	25	

The minutes of the degrees of the Quadrant for the right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the right Sines of the coplements of the Arches of the same Quadrant.

The degrees of the Quadrant for the right Sines

of the Arches of the same Quadrant.

	60	61	62	63	64	
30	8703557	8788171	8870108	8949344	9025853	30
31	8704989	8789559	8871451	8950642	9027105	29
32	8706420	8790946	8872793	8951939	9028356	28
33	8707851	8792332	8874134	8953235	9029606	27
34	8709281	8793717	8875475	8954530	9030856	26
35	8710710	8795102	8876815	8955824	9032105	25
36	8712138	8796486	8878154	8957117	9033353	24
37	8713565	8797869	8879492	8958410	6034600	23
38	8714992	8799251	8880830	8959702	9035847	22
39	8716418	8800633	8882167	8960994	9037093	21
40	8717844	8802014	8883503	8962285	9038338	20
41	8719269	8803394	8884838	8963575	9039582	19
42	8720693	8804773	8886172	8964864	9040825	18
43	8722116	8806151	8887506	8966152	9042068	17
44	8723538	8807530	8888839	8967440	9043310	16
45	8724960	8808907	8890171	8968727	9044551	15
46	8726381	8810283	8891502	8970013	9045791	14
47	8727801	8811659	8892833	8971299	9047031	13
48	8729221	8813034	8894163	8972584	9048270	12
49	8730640	8814408	8895492	8973868	9049508	11
50	8732058	8815782	8896821	8975151	9050746	10
51	8733475	8817155	8898149	8976433	9051983	9
52	8734891	8818527	8899476	8977715	9053219	8
53	8736307	8819898	8900802	8978996	9054454	7
54	8737722	8821268	8902127	8980276	9055688	6
55	8739137	8822638	8903452	8981555	9056922	5
56	8740551	8824007	8904776	8982833	9058155	4
57	8741964	8825375	8906099	8984111	9059387	3
58	8743376	8826743	8907422	8985388	9060618	2
59	8744787	8828110	8908744	8986664	9061848	1
60	8746197	8829476	8910065	8987940	9063078	0
	25	26	27	28	29	

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the complements of the Arches of the same Quadrant.

of the complements of the Arches of the same Quadrant.

The Table of Sines.

The degrees of the Quadrant for right Sines

	65	66	67	68	69	
0	9063078	9135455	9205049	9271839	9335804	60
1	9064307	9136638	9206185	9272928	9336840	59
2	9065535	9137820	9207321	9274017	9337887	58
3	9066763	9139001	9208456	9275105	9338928	57
4	9067990	9140181	9209590	9276192	9339968	56
5	9069216	9141361	9210723	9277278	9341007	55
6	9070441	9142540	9211855	9278363	9342045	54
7	9071665	9143718	9212986	9279448	9343082	53
8	9072889	9144895	9214117	9280532	9344119	52
9	9074112	9146072	9215247	9281615	9345155	51
10	9075334	9147248	9216376	9282697	9346190	50
11	9076555	9148423	9217504	9283778	9347224	49
12	9077775	9149597	9218631	9284859	9341257	48
13	9078995	9150770	9219758	9285939	9349289	47
14	9080214	9151943	9220884	9287018	9350321	46
15	9081432	9153115	9222010	9288096	9351352	45
16	9082649	9154286	9223135	9289173	9352382	44
17	9083866	9155457	9224259	9290250	9353411	43
18	9085082	9156627	9225382	9291326	9354440	42
19	9086297	9157796	9226504	9292401	9355468	41
20	9087512	9158964	9227625	9293476	9356495	40
21	9088726	9160131	9228746	9294550	9357521	39
22	9089939	9161297	9229866	9295623	9358546	38
23	9091151	9162463	9230985	9296695	9359571	37
24	9092362	9163628	9232103	9297766	9360595	36
25	9093572	9165792	9233220	9298836	9361618	35
26	9094781	9165955	9234337	9299905	9362640	34
27	9095990	9167117	9235453	9300974	9363662	33
28	9097198	9168279	9236568	9302042	9364683	32
29	9098406	9169440	9237682	9303109	9365703	31
30	9099613	9170601	9238795	9304176	9366722	30
	24	23	22	21	20	

The degrees of the Quadrant for right Sines

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the cõplements of the Arches of the same Quadrant.

of the Arches of the ſame Quadrant.

	65	66	67	68	69	
30	9099613	9170601	9238795	9304176	9366722	30
31	9100819	9171761	9239908	9305242	9367740	29
32	9102024	9172920	9241020	9306307	9368758	28
33	9103228	9174078	9242131	9307371	9369775	27
34	9104432	9175231	9243242	9308434	9370791	26
35	9105636	9176393	9244352	9309497	9371806	25
36	9106837	9177547	9245461	9310559	9372820	24
37	9108038	9178702	9246569	9311620	9373834	23
38	9109238	9179856	9247676	9312680	9374847	22
39	9110438	9181009	9248782	9313739	9375859	21
40	9111637	9182161	9249888	9314798	9376870	20
41	9112835	9183313	9250993	9315856	9377880	19
42	9114032	9184464	9252097	9316913	9378889	18
43	9115229	9185614	9253200	9317969	9379898	17
44	9116425	9186763	9254303	9319024	9380906	16
45	9117620	9187912	9255405	9320079	9381913	15
46	9118814	9189060	9256506	9321133	9382919	14
47	9120007	9190207	9257606	9322186	9383925	13
48	9121200	9191353	9258706	9323238	9384930	12
49	9122392	9192499	9259805	9324290	9385934	11
50	9123584	9193644	9260963	9325241	9386937	10
51	9124775	9194788	9262000	9326291	9387939	9
52	9125965	9195931	9263096	9327440	9388941	8
53	9127154	9197073	9264192	9328488	9389942	7
54	9128342	9198215	9265287	9329535	9390942	6
55	9129529	9199356	9266381	9330582	9391941	5
56	9130716	9200496	9267474	9331628	9392940	4
57	9131902	9201635	9268566	9332673	9393938	3
58	9133087	9202774	9269658	9333717	9394935	2
59	9134271	9203912	9270749	9334761	9395931	1
60	9135455	9205049	9271839	9335804	9396926	0
	24	23	22	21	20	

The minutes of the degrees of the Quadrant for right Sines of the Arches of the ſame Quadrant.

The minutes of degrees of the Quadrant for right Sines of the complements of the Arches of the ſame Quadrant

The Table of Sines.

The degrees of the Quadrant for right Sines

	70	71	72	73	74	
0	9396926	9455186	9510565	9563048	9612617	60
1	9397921	9456133	9511464	9563898	9613418	59
2	9398915	9457079	9512362	9564747	9614219	58
3	9399908	9458024	9513259	9565596	9615019	57
4	9400900	9458968	9514155	9566444	9615818	56
5	9401891	9459911	9515050	9567291	9616616	55
6	9402882	9460854	9515944	9568137	9617413	54
7	9403872	9461796	9516838	9568982	9618209	53
8	9404861	9462737	9517731	9569826	9619005	52
9	9405849	9463677	9518623	9570670	0619800	51
10	9406836	9464616	9519514	9571513	9620594	50
11	9407822	9465555	9520404	9572355	9621387	49
12	9408808	9466493	9521294	9573196	9622179	48
13	9409793	9467430	9522183	9574036	9622971	47
14	9410777	9468366	9523071	9574875	9623762	46
15	9411760	9469301	9523958	9575714	9624552	45
16	9412742	9470236	9524844	9576552	9625341	44
17	9413724	9471170	9525730	9577389	9626129	43
18	9414705	9472103	9526615	9578225	9626917	42
19	9415685	9473035	9527499	9579061	9627704	41
20	9416665	9473967	9528382	9579896	9628490	40
21	9417644	9474898	9529264	9580730	9629275	39
22	9418622	9475828	9530146	9581563	9630059	38
23	9419599	9476757	9531027	9582395	9630843	37
24	9420575	9477685	9531907	9583226	9631626	36
25	9421550	9478612	9532786	9584057	9632408	35
26	9422525	9479539	9533664	9584887	9633189	34
27	9423499	9480465	9534541	9585716	9633969	33
28	9425472	9481390	9535418	9586544	9634748	32
29	9425444	9482314	9536294	9587371	9635527	31
30	9426415	9483237	9537169	9588197	9636305	30
	19	18	17	16	15	

The minutes of degrees of the Quadrant for right Sines of the Arches of the Quadrant.

The minutes of degrees of the Quadrant for right Sines of the cõplements of the Arches of the same Quadrant.

The degrees of the Quadrant for right Sines

of the Arches of the same Quadrant.

	70	71	72	73	74	
30	9426415	9483237	9537169	9588197	9635305	30
31	9427386	9484160	9538043	9589023	9637082	29
32	9428356	9485082	9538917	9589848	9637858	28
33	9429325	9486003	9539790	9590672	9638633	27
34	9430293	9486923	9540662	9591495	9639408	26
35	9431260	9487842	9541533	9592318	9640182	25
36	9432227	9488761	9542403	9593140	9640955	24
37	9433193	9489679	9543272	9593961	9641727	23
38	9434158	9490596	9544141	9594781	9642498	22
39	9435122	9491512	9545009	9595600	9643268	21
40	9436085	9492427	9545876	9596419	9644038	20
41	9437048	9493341	9546742	9597237	9644807	19
42	9438010	9494255	9547607	9598054	9645575	18
43	9438971	9495168	9548472	9598870	9646342	17
44	9439931	9496080	9549336	9599685	9647108	16
45	9440890	9496991	9550199	9600499	9647873	15
46	9441849	9497902	9551061	9601313	9648638	14
47	9442807	9498812	9551922	9602126	9649402	13
48	9443764	9499721	9552783	9602938	9650165	12
49	9444720	9500629	9553643	9603749	9650927	11
50	9445676	9501536	9554502	9604559	9651689	10
51	9446631	9502443	9555360	9605368	9652450	9
52	9447585	9503349	9556217	9606177	9653210	8
53	9448538	9504254	9557074	9606985	9653969	7
54	9449490	9505158	9557930	9607792	9654727	6
55	9450441	9506061	9558785	9608598	9655484	5
56	9451392	9506963	9559639	9609403	9656240	4
57	9452342	9507865	9560492	9610208	9656996	3
58	9453291	9508766	9561345	9611012	9657751	2
59	9454239	9509666	9562197	9611815	9658505	1
60	9455186	9510565	9563048	9612617	9659258	0
	19	18	17	16	15	

of the complements of the Arches of the same Quadrant

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the complements of the Arches of the same Quadrant

The Table of Sines.

The degrees of the Quadrant for the right Sines

	75	76	77	78	79	
0	9659258	9702957	9743600	9781476	9816272	60
1	9660011	9703660	9744355	9782080	9816827	59
2	9660163	9704363	9745008	9782684	9817381	58
3	9661514	9705065	9745660	9783281	9817934	57
4	9662264	9705766	9746312	9783889	9818486	56
5	9663013	9706466	9746963	9784490	9819037	55
6	9663761	9701659	9747013	9785090	9819587	54
7	9664508	9707863	9748262	9785689	9820137	53
8	9665255	9708561	9748910	9786288	9820686	52
9	9666001	9709258	9749557	9786886	9821234	51
10	9666746	9709954	9750203	9787483	9821781	50
11	9667490	9710649	9750849	9788079	9822327	49
12	9668233	9711343	9751494	9788674	9822872	48
13	9668976	9712036	9752138	9789268	9823417	47
14	9669718	9712729	9752781	9789862	9823961	46
15	9670459	9713421	9753424	9790455	9824504	45
16	9671199	9714112	9754065	9791047	9825046	44
17	9671938	9714802	9754706	9791638	9825587	43
18	9672677	9715491	9755346	9792228	9826128	42
19	9673415	9716180	9755985	9792818	9826668	41
20	9674152	9716868	9756623	9793407	9827207	40
21	9674888	9717555	9757260	9793995	9822443	39
22	9675623	9718241	9757897	9794582	9828282	38
23	9676357	9718926	9758533	9795168	9828818	37
24	9677091	9719610	9759168	9795753	9826354	36
25	9677824	9720294	9759802	9796337	9829889	35
26	9678556	9720977	9760435	9796921	9830423	34
27	9679287	9721659	9761067	9797504	9830956	33
28	9680017	9722340	9761699	9798086	9831488	32
29	9680747	9723020	9762330	9798667	9832069	31
30	9681476	9723699	9762960	9799247	9832549	30
	14	13	12	11	10	

The minutes of the degrees of the Quadrant for the right Sines

The minutes of degrees of the Quadrant for the right Sines fo the cõplements of the Arches of the same Quadrat.

The degrees of the Quadrant for the right Sines

of the Arches of the same Quadrant.

	75	76	77	78	79	
30	9681476	9723699	9762960	9799247	9832549	30
31	9682805	9724378	9763589	9799827	9833079	29
32	9682931	9725056	9764217	9800406	9833608	28
33	9683657	9725733	9764843	9800984	9834136	27
34	9684383	9726409	9765472	9801561	9834663	26
35	9685108	9727085	9766098	9802137	9835189	25
36	9685832	9727760	9766723	9802712	9835714	24
37	9686555	9728434	9767347	9803287	9836239	23
38	9687277	9729197	9767970	9803861	9836763	22
39	9687998	9729779	9768593	9804434	9837286	21
40	9688719	9730450	9769215	9805006	9837808	20
41	9689439	9731120	9769836	9805577	9838329	19
42	9690158	9731789	9770456	9806147	9838850	18
43	9690879	9732458	9771075	9806716	9839370	17
44	9691593	9733126	9771693	9807285	9839889	16
45	9692309	9733793	9772311	9807853	9840407	15
46	9693025	9734459	9772928	9808420	9840924	14
47	9693740	9735124	9773544	9808986	9841440	13
48	9694454	9735789	9775159	9809551	9841959	12
49	9695167	9736453	9774773	9810116	9842471	11
50	9695879	9737116	9775387	9810680	9842985	10
51	9696590	9737778	9776000	9811243	9843498	9
52	9697301	9738439	9776612	9811805	9844010	8
53	9698011	9739099	9777223	9812366	9844521	7
54	9698720	9739759	9777833	9812926	9845032	6
55	9699428	9740418	9778442	9813486	9845542	5
56	9700135	9741076	9779050	9814045	9846051	4
57	9700842	9741733	9779658	9814603	9846559	3
58	9701542	9742389	9780265	9815160	9849066	2
59	9702253	9743045	9780871	9815716	9847572	1
60	9702957	9743700	9781476	9816272	9848078	0
	14	13	12	11	10	

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the cõplements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Sines.

The degrees of the Quadrant for the right Sines

	8	81	82	83	84	
0	9848078	9876883	9902681	9925461	9945219	60
1	9848583	9877338	9903085	9925816	9945523	59
2	9849087	9877794	9903489	9926169	9945826	58
3	9849590	9878245	9903892	9926521	9946128	57
4	9850093	9878097	9904294	9926873	9946429	56
5	9850593	9879148	9904695	9927224	9946729	55
6	9851093	9879598	9905095	9927574	9947028	54
7	9851593	9880048	9905494	9927923	9947337	53
8	9852092	9880497	9905893	9928271	9947625	52
9	9852590	9880945	9906291	9528618	9947622	51
10	9853087	9881392	9906688	9928965	9948218	50
11	9853583	9881838	9907084	9929311	9948513	49
12	9854079	9882283	9907479	9929656	9948807	48
13	9854574	9882728	9907873	9930000	9949100	47
14	9855068	9883172	9908266	9930343	9949393	46
15	9855561	9883615	9908659	9930685	9949685	45
16	9856053	9884057	9909051	9931026	9949976	44
17	9856544	9884498	9909442	9931367	9950266	43
18	9857035	9884938	9909832	9931707	9950555	42
19	9857525	9885378	9910221	9932046	9950844	41
20	9858014	9885817	9910610	9932384	9951132	40
21	9858502	9886255	9910998	9932721	9951419	39
22	9858989	9886692	9911385	9933057	9951705	38
23	9859475	9887128	9911771	9933393	9951990	37
24	9859961	9887564	9912156	9933728	9952274	36
25	9860446	9887999	9912540	9934062	9952557	35
26	9860930	9888433	9912923	9934395	9952840	34
27	9861413	9888866	9913306	9934727	9953122	33
28	9861895	9889298	9913688	9935058	9953403	32
29	9862376	9889729	9914069	9935389	9953683	31
30	9862856	9890159	9914449	9935719	9953962	30
	9	8	7	6	5	

The degrees of the Quadrant for the right Sines

The minutes of the degrees of the Quadrant for the right Sines of the Arches of the same Quadrat.

The minutes of degrees of the Quadrant for the right Sines of the coplements of the Arches of the same Quadrat.

The Table of Sines.

of the Arches of the same Quadrant.

	80	81	82	83	84	
30	9862856	9890159	9914449	9935719	9953962	30
31	9863336	9890588	9914828	9936048	9954240	29
32	9863815	9891017	9915206	9936376	9954518	28
33	9864293	9891445	9915584	9936703	9954795	27
34	9864770	9891872	9915961	9937029	9955071	26
35	9865246	9892298	9916337	9937355	9955346	25
36	9865722	9892723	9916712	9937680	9955620	24
37	9866197	9893147	9917086	9938004	9955893	23
38	9866671	9893571	9917459	9938327	9956165	22
39	9867144	9893994	9917832	9938649	9956437	21
40	9867616	9894416	9918204	9938970	9956708	20
41	9868087	9894837	9918575	9939290	9956978	19
42	9868559	9895257	9918945	9939609	9957247	18
43	9869027	9895677	9919314	9939928	9957515	17
44	9869496	9896096	9919682	9940246	9957782	16
45	9869964	9896514	9920049	9940563	9958049	15
46	9870431	9896931	9920416	9940879	9958315	14
47	9870897	9897347	9920782	9941194	9958580	13
48	9871362	9897762	9921147	9941509	9958844	12
49	9871827	9898177	9921511	9941823	9959307	11
50	9872291	9898591	9921874	9942136	9959370	10
51	9872754	9899004	9922236	9942448	9959632	9
52	9873216	9899416	9922598	9942759	9959893	8
53	9873677	9899827	9922959	9943069	9960153	7
54	9874137	9900237	9923319	9943379	9960412	6
55	9874597	9900646	9923678	9943688	9960670	5
56	9875056	9901055	9924036	9943996	9960927	4
57	9875514	9901463	9924393	9944303	9961183	3
58	9875971	9901870	9924750	9944750	9961438	2
59	9876427	9902276	9925106	9944914	9961693	1
60	9876883	9902681	9925461	9945219	9961947	0
	9	8	7	6	5	

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the coplements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant.

The Table of Sines.

The degrees of the Quadrant for the right Sines

	85	86	87	88	89	
0	9961947	9975640	9986295	9993908	9998477	60
1	9962200	9975843	9986447	9994009	9998527	59
2	9962452	9976045	9986598	9994109	9998576	58
3	9962703	9976246	9986748	9994208	9998625	57
4	9962954	9976446	9986897	9994307	9998673	56
5	9963204	9976645	9987045	9994405	9998720	55
6	9963453	9976843	9987193	9994502	9998766	54
7	9963701	9977040	9987340	9994598	9998811	53
8	9963948	9977237	9987486	9994693	9998855	52
9	9964194	9977433	9987631	9994787	9998899	51
10	9964440	9977628	9987775	9994881	9998942	50
11	9964685	9977822	9987918	9994974	9998984	49
12	9964929	9978015	9988061	9995066	9999025	48
13	9965172	9978207	9988203	9995157	9999065	47
14	9965414	9978398	9988344	9995247	9999104	46
15	9965655	9978589	9988484	9995336	9999143	45
16	9965895	9978779	9988623	9995424	9999181	44
17	9966235	9978968	9988761	9995512	9999218	43
18	9966374	9979156	9988899	9995599	9999254	42
19	9966612	9979343	9989036	9995685	9999289	41
20	9966849	9979530	9989172	9995770	9999323	40
21	9967085	9979716	9989307	9995854	9999356	39
22	9967320	9979901	9989441	9995937	9999389	38
23	9967555	9980085	9989574	9996019	9999421	37
24	9967789	9980268	9989706	9996101	9999452	36
25	9968022	9980450	9989837	9996182	9999482	35
26	9968254	9980631	9989968	9996262	9999511	34
27	9968485	9980811	9990098	9996341	9999539	33
28	9968715	9980992	9990227	9996419	9999560	32
29	9968944	9981170	9990355	9996496	9999593	31
30	9969173	9981348	9990482	9996573	9999619	30
	4	3	2	1	0	

The minutes of the degrees of the Quadrant for the right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the right Sines of the cõplements of the Arches of the same Quadrant.

The degrees of the Quadrant for the right Sines

of the Arches of the same Quadrant.

	85	86	87	88	89	
30	9969173	9981348	9990482	9996573	9999616	30
31	9969401	9981525	9990608	9996649	9999644	29
32	9969628	9981701	9990734	9996724	9999668	28
33	9969854	9981877	9990859	9996798	9999691	27
34	9970079	9982052	9990983	9996871	9999713	26
35	9970304	9982226	9991106	9996943	9999735	25
36	9970528	9982399	9991228	9997014	9999756	24
37	9970751	9982571	9991349	9997085	9999776	23
38	9970973	9982742	9991470	9997155	9999795	22
39	9971194	9982912	9991590	9997224	9999813	21
40	9971414	9983082	9991709	9997293	9999830	20
41	9971633	9983251	9991827	9997359	9999846	19
42	9971851	9983419	9991944	9997425	9999862	18
43	9972069	9983586	9992060	9997491	9999877	17
44	9972286	9983752	9992175	9997556	9999891	16
45	9972502	9983917	9992290	9997620	9999904	15
46	9972717	9984081	9992404	9997683	9999916	14
47	9972931	9984245	9992517	9997745	9999927	13
48	9973145	9984408	9992629	9997806	9999938	12
49	9973358	9984570	9992740	9997867	9999948	11
50	9973570	9984731	9992850	9997927	9999957	10
51	9973781	9984891	9992960	9997986	9999965	9
52	9973991	9985050	9993069	9998044	9999972	8
53	9974200	9985209	9993177	9998101	9999978	7
54	9974408	9985367	9993284	9998157	9999984	6
55	9974615	9985524	9993390	9998212	9999989	5
56	9974822	9985680	9993495	9998267	9999993	4
57	9975028	9985835	9993599	9998321	9999996	3
58	9975233	9985989	9993703	9998374	9999998	2
59	9975437	9986143	9993806	9998426	9999999	1
60	9975640	9986295	9993908	9998477	10000000	0
	4	3	2	1	0	

The minutes of the degrees of the Quadrant for right Sines of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for right Sines of the coplements of the Arches of the same Quadrat.

of the complements of the Arches of the same Quadrant.

THE TABLE OF TANGENTS OTHER-WISE CALLED THE FRVITFVLL TABLE.

The Table of Tangents.

The degrees of the Quadrant for Tangents.

	0	1	2	3	4	
0	0000	174550	349207	524078	699269	60
1	2909	177459	352120	526995	702193	59
2	5818	180369	355033	529911	705116	58
3	8727	183279	357945	532828	708039	57
4	11635	186189	360858	535745	710962	56
5	14544	189100	363770	538663	713886	55
6	17452	192010	366683	541580	716809	54
7	20361	194920	369596	544498	719733	53
8	23270	197830	372508	547415	722657	52
9	26179	200740	375421	550333	725580	51
10	29088	203650	378334	553251	728504	50
11	31996	206561	381247	556169	731428	49
12	34905	209471	384160	559087	734353	48
13	37814	212381	387073	562005	737277	47
14	40723	215291	389987	564923	740202	46
15	43632	218201	392900	567841	743127	45
16	46541	221111	395814	570759	746052	44
17	49450	224022	398727	573678	748978	43
18	52359	226932	401641	576596	751903	42
19	55268	229842	404554	579514	754829	41
20	58177	232752	507468	582432	757754	40
21	61086	235663	410382	585352	760680	39
22	63995	238574	413295	588270	763606	38
23	66904	241485	416209	591189	766532	37
24	69813	244395	419123	594108	769459	36
25	72722	247306	422037	597028	772385	35
26	75631	250217	424951	599947	775311	34
27	78540	253128	427866	602866	778238	33
28	81450	256038	430780	605786	781164	32
29	84359	258949	433694	608705	784091	31
30	87268	261859	436609	611625	787017	30
	89	88	87	86	85	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the coplements of the Arches of the same Quadrat.

The degrees of the Quadrant for the Tangents

of the Arches of the same Quadrant.

	0	1	2	3	4	
30	87268	261859	436609	611125	787017	30
31	90177	264770	439524	614543	789944	29
32	93086	267681	442438	617464	792871	28
33	95995	270592	445353	620384	795799	27
34	98904	273503	448267	623304	798726	26
35	101810	276414	451182	626225	801653	25
36	104723	279325	454097	629145	804581	24
37	107632	282237	457012	632066	807509	23
38	110541	285148	459927	634986	810437	22
39	113450	288059	462842	637907	813365	21
40	116360	290970	465757	640828	816293	20
41	119269	293882	468672	643749	819221	19
42	122178	296794	471588	646671	822150	18
43	125088	299705	474503	649592	825079	17
44	127997	302617	477419	652514	828008	16
45	130906	305528	480335	655435	830937	15
46	133816	308439	483251	658357	833866	14
47	136725	311352	486166	661278	836795	13
48	139635	314261	489082	664200	839724	12
49	142544	317174	491997	667121	842653	11
50	145454	320085	494913	670043	845583	10
51	148363	322997	497829	672965	848513	9
52	151273	355909	500742	675888	851443	8
53	154182	322821	503662	678810	854374	7
54	159092	331733	506578	681733	857304	6
55	160001	334645	509495	684656	860234	5
56	162911	337558	512411	687578	863164	4
57	165820	340470	515328	690501	866095	3
58	168730	343382	518244	693423	869025	2
59	171640	346295	521161	696346	871956	1
60	174550	349207	524078	699269	874886	0
	89	88	87	86	85	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrat.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrant.

of the complements of the Arches of the same Quadrant

The Table of Tangents

The degrees of the Quadrant for the Tangents

	5	6	7	8	9	
0	874886	1051042	1227846	1405408	1583844	60
1	877817	1053983	1230798	1408374	1586820	59
2	880748	1056924	1233751	1411341	1589808	58
3	883680	1059866	1236704	1414308	1592791	57
4	886611	1062808	1239658	1417275	1595774	56
5	889543	1065750	1242612	1420242	1598757	55
6	892475	1068692	1245566	1423210	1601740	54
7	895407	1071634	1248520	1426178	1604723	53
8	898339	1074576	1251474	1429146	1607707	52
9	901271	1077518	1254428	1432115	1610691	51
10	904204	1086461	1257383	1435084	1613675	50
11	907137	1083404	1260338	1438053	1616660	49
12	910070	1086347	1263293	1441022	1619645	48
13	913003	1089291	1266249	1443992	1622630	47
14	915936	1092234	1269205	1446961	1625615	46
15	918870	1095178	1272161	1449931	1627601	45
16	921804	1098122	1275117	1452901	1631587	44
17	924738	1101066	1278073	1455871	1634573	43
18	927771	1104010	1281029	1458842	1637560	42
19	930605	1106954	1283986	1461813	1640547	41
20	933539	1109899	1286943	1464784	1643534	40
21	936473	1112844	1289900	1467755	1646522	39
22	939407	1115789	1292857	1470727	1649510	38
23	942342	1118734	1295815	1473699	1652499	37
24	945277	1121680	1298773	1476671	1655488	36
25	948212	1124625	1301731	1479644	1658477	35
26	951147	1127571	1304689	1482617	1661466	34
27	954083	1130517	1307648	1485590	1664456	33
28	957019	1133463	1310607	1488563	1667446	32
29	959954	1136409	1313566	1491536	1670436	31
30	962890	1139355	1316525	1494510	1673426	30
	84	83	82	81	80	

The degrees of the Quadrant for the Tangents

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the coplements of the Arches of the same Quadrant.

	5	6	7	8	9	
30	962890	1139355	1316525	1494510	1673426	30
31	965826	1142302	1319485	1497484	1676417	29
32	868763	1145249	1322445	1500458	1679408	28
33	971699	1148196	1325405	1503433	1682399	27
34	974636	1151144	1328365	1506408	1685390	26
35	977573	1154092	1331325	1509383	1688382	25
36	980509	1157040	1334285	1512358	1691374	24
37	983446	1159988	1337246	1515334	1694366	23
38	986383	1162936	1340207	1518310	1697358	22
39	989320	1165884	1343168	1521286	1700351	21
40	992257	1168832	1346129	1524262	1703344	20
41	995195	1171781	1349091	1527239	1706337	19
42	998133	1174730	1352053	1530216	1709331	18
43	1001072	1177679	1355015	1533193	1712325	17
44	1004010	1180628	1357977	1536170	1715319	16
45	1006949	1183577	1360940	1539148	1718313	15
46	1009887	1186527	1363903	1542126	1721308	14
47	1012825	1189477	1366866	1545104	1724304	13
48	1015763	1192427	1369830	1548082	1727300	12
49	1018702	1195377	1372793	1551061	1730296	11
50	1021641	1198328	1375757	1554040	1733292	10
51	1024580	1201279	1378721	1557019	1736287	9
52	1027519	1204230	1381686	1559999	1739284	8
53	1030459	1207181	1384650	1562979	1742281	7
54	1033399	1210132	1387615	1565959	1745278	6
55	1036339	1213084	1390580	1568939	1748275	5
56	1039279	1216036	1393545	1571920	1751273	4
57	1042219	1218988	1396510	1574901	1754271	3
58	1045160	1221940	1399476	1577882	1757270	2
59	1048101	1224892	1402442	1580863	1760269	1
60	1051042	1227845	1405408	1583844	1763268	0
	84	83	82	81	80	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Tangents of the complements of the Arches of the same Quadrant.

The Table of Tangents

The degrees of the Quadrant for the Tangents

	10	11	12	13	14	
0	1763268	1943803	2125565	2308682	2493280	60
1	1766268	1946822	2128605	2311746	2496370	59
2	1769268	1949841	2131646	2314810	2499411	58
3	1772268	1952861	2134687	2317875	2502552	57
4	1775269	1955881	2137729	2320940	2505643	56
5	1778270	1958901	2140771	2324006	2508735	55
6	1781271	1961922	2143814	2327072	2511827	54
7	1784272	1964943	2146857	2330139	2514920	53
8	1787274	1967964	2149900	2333206	2518013	52
9	1790276	1970985	2152944	2336273	2521106	51
10	1793278	1974007	2155988	2339341	2524200	50
11	1796281	1977029	2159032	2342419	2527294	49
12	1799284	1980052	2162077	2345478	2530389	48
13	1802287	1983075	2165122	2348547	2533484	47
14	1805291	1986098	2168167	2351616	2536580	46
15	1808295	1989122	2171213	2354686	2539676	45
16	1811299	1992146	2174259	2357757	2542773	44
17	1814303	1995171	2177306	2360828	2545870	43
18	1817308	1998196	2180352	2363899	2548968	42
19	1820313	2001221	2183400	2366971	2552066	41
20	1823318	2004247	2186448	2370043	2555165	40
21	1826324	2007273	2189496	2373116	2558264	39
22	1829329	2010299	2192544	2376189	2561364	38
23	1832335	2013326	2192544	2379263	2564464	37
24	1835342	2016353	2195593	2382337	2567564	36
25	1838349	2019380	2201692	2385411	2570665	35
26	1841357	2022408	2204742	2388486	2573766	34
27	1844365	2025436	2207792	2391561	2576868	33
28	1847373	2028464	2210843	2394636	2579970	32
29	1850382	2031493	2213894	2397712	2583073	31
30	1853391	2034522	2216946	2400788	2586176	30
	79	78	77	76	75	

The degrees of the Quadrant for the Tangents

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the coplements of the Arches of the same Quadrant.

	10	11	12	13	14	
30	1853301	2034522	2216946	2400788	2586176	30
31	1856400	2037552	2219998	2403865	2589280	29
32	1859409	2040582	2223051	2406942	2592384	28
33	1862419	2043612	2226104	2410020	2595489	27
34	1865429	2046643	2229157	2413098	2598594	26
35	1868439	2049674	2232211	2416176	2601700	25
36	1871449	2052705	2235265	2419255	2604806	24
37	1874460	2055737	2238319	2422334	2607912	23
38	1877471	2058769	2241374	2425414	2611019	22
39	1880482	2061801	2244429	2428494	2614126	21
40	1883494	2064834	2247485	2431574	2617234	20
41	1886506	2067867	2250541	2434655	2620342	19
42	1889516	2070900	2253597	2437736	2623451	18
43	1892531	2073934	2256654	2440818	2626560	17
44	1895544	2076968	2259711	2443900	2629670	16
45	1898558	2080002	2262769	2446983	2632780	15
46	1901572	2083037	2265827	2450066	2635891	14
47	1904586	2086073	2268885	2453150	2639002	13
48	1907601	2089109	2271944	2456234	2642114	12
49	1910616	2092145	2275003	2459319	2645226	11
50	1913632	2095182	2278063	2462404	2648339	10
51	1916648	2098219	2281123	2465490	2651452	9
52	1999664	2101256	2284183	2468576	2654566	8
53	1922680	2104293	2287244	2471662	2657680	7
54	1925697	2107331	2290305	2474749	2660795	6
55	1928714	2110369	2293367	2477836	2663910	5
56	1931731	2113407	2296429	2480924	2667026	4
57	1934749	2116446	2299492	2484012	2670142	3
58	1937767	2119485	2302555	2487101	2673258	2
59	1940785	2122525	2305618	2490191	2676375	1
60	1943803	2125565	2308682	2493280	2679493	0
	79	78	77	76	57	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the complements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Tangents.

The degrees of the Quadrant for the Tangents

	15	16	17	18	19	
0	2679492	2867453	3057307	3249197	3443276	60
1	2682610	2870601	3060487	3252413	3446530	59
2	2685728	2873749	3063669	3255630	3449785	58
3	2688847	2876898	3066851	3258848	3453040	57
4	2691966	2880048	3070034	3262066	3456296	56
5	2695086	2883198	3073218	3265285	3459553	55
6	2698206	2886349	3076402	3268504	3462810	54
7	2701327	2889501	3079587	3271724	3466068	53
8	2704448	2892653	3082772	3274944	3469326	52
9	2707570	2895806	3085958	3278165	3472585	51
10	2710693	2898960	3085144	3281387	3475845	50
11	2713816	2902114	3092331	3284609	3479105	49
12	2716940	2905268	3095518	3287832	3482366	48
13	2720064	2908423	3198706	3291055	3485628	47
14	2723189	2911578	3101895	3294280	3488891	46
15	2726314	2914734	3105084	3297505	3492154	45
16	2729439	2917890	3108274	3300731	3495418	44
17	2732565	2921047	3111464	3303957	3498683	43
18	2735691	2924204	3114655	3307184	3501949	42
19	2738818	2927362	3117846	3310411	3505215	41
20	2741945	2930520	3121038	3313639	3508482	40
21	2745073	2933679	3124230	3316868	3511749	39
22	2748201	2936839	3127423	3320097	3515017	38
23	2751330	2939999	3130617	3323327	3518286	37
24	2754459	2943160	3133811	3326558	3521555	36
25	2757589	2946321	3137006	3329789	3524825	35
26	2760729	2946483	3140201	3333020	3528096	34
27	2763850	2952645	3143397	3336252	3531368	33
28	2766981	2955808	3146594	3339485	3534640	32
29	2770113	2958971	3149791	3342719	3537913	31
30	2773245	2962135	3152989	3345953	3541186	30
	74	73	72	71	70	

The degrees of the Quadrant for the Tangents

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrat for the coplements of the Arches of the same Quadrat.

	15	16	17	18	19	
30	2773245	2962135	3152989	3345953	3541186	30
31	2776378	2965299	3156187	3349188	3544460	29
32	2779511	2968464	3159386	3352423	3547735	28
33	2782645	2971629	3162585	3355659	3551010	27
34	2785779	2974795	3165785	3358896	3554286	26
35	2788914	2977962	3168986	3362133	3557563	25
36	2792050	2981129	3172187	3365371	3560840	24
37	2795186	2984297	3175389	3368610	3564118	23
38	2798323	2987465	3178591	3371850	3567397	22
39	2801460	2990634	3181794	3375090	3570676	21
40	2804597	2993804	3184998	3378331	3573956	20
41	2807735	2996973	3188202	3381572	3577237	19
42	2810873	3000143	3191407	3384814	3580519	18
43	2814012	3003314	3194613	3388057	3583801	17
44	2817151	3006486	3197819	3391300	3587084	16
45	2820291	3009658	3201026	3394544	3590367	15
46	2823432	3012831	3204233	3397798	3593651	14
47	2826573	3016004	3207441	3401033	3596936	13
48	2829714	3019178	3210649	3404279	3600221	12
49	2832856	3022353	3213858	3407525	3603507	11
50	2835999	3025528	3217067	3410772	3606794	10
51	2839142	3028703	3220277	3414020	3610082	9
52	2842286	3031879	3223488	3417268	3613370	8
53	2845430	3035055	3226699	3420517	3616659	7
54	2848575	3038232	3229911	3423766	3619949	6
55	2851720	3041410	3233124	3427016	3623239	5
56	2854866	3044588	3236337	3430267	3626530	4
57	2858012	3047767	3239551	3433518	3629822	3
58	2861159	3050946	3242766	3436770	3633115	2
59	2864306	3054126	3245981	3440023	3636408	1
60	2867453	3057307	3249197	3443276	3639702	0
	74	73	72	71	70	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the complements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant.

The Table of Tangents.

The degrees of the Quadrant for the Tangents

The minutes of the degrees of the Quadrant for the Arches of the same Quadrant.

	20	21	22	23	24	
0	3639702	3838640	4040262	4244748	4452286	60
1	3642997	3841978	4043647	4248182	4455772	59
2	3646293	3845316	4047031	4251617	4459259	58
3	3649589	3848655	4050416	4255052	4462747	57
4	3652886	3851995	4053802	4258488	4466236	56
5	3656183	3855336	4057189	4261925	4469726	55
6	3659481	3858678	4060577	4265363	4473216	54
7	3662780	3862020	4063966	4268801	4476707	53
8	3666079	3865363	4067356	4265363	4480199	52
9	3669379	3868707	4070747	4268801	4483692	51
10	3672680	3872052	4074139	4272240	4487186	50
11	3675982	3875397	4077531	4279121	4490681	49
12	3679284	3878743	4080924	4282563	4494177	48
13	3682587	3882090	4084318	4286006	4497674	47
14	3685891	3885438	4087713	4289450	4501172	46
15	3689195	3888787	4091109	4292895	4504671	45
16	3692500	3892136	4094506	4296340	4508171	44
17	3695806	3895486	4097903	4299786	4511672	43
18	3699113	3898837	4101301	4303233	4515173	42
19	3702420	3902188	4104699	4306681	4518675	41
20	3705728	3905540	4108097	4310130	4522178	40
21	3709037	3908893	4111497	4310130	4525682	39
22	3712347	3912247	4114898	4313580	4529187	38
23	3715657	3915061	4118300	4317031	4532693	37
24	3718968	3918956	4121703	4327387	4536200	36
25	3722279	3922312	4125107	4330841	4539708	35
26	3725591	3925669	4128511	4334296	4543217	34
27	3728904	3929027	4131916	4337752	4546727	33
28	3732218	3932385	4135322	4341209	4550238	32
29	3735533	3935744	4138728	4344666	4553750	31
30	3738848	3939104	4142135	4348124	4557264	30
	69	68	67	66	65	

The minutes of degrees of the Quadrant for the Tangents of the coplements of the Arches of the same Quadrat.

The degrees of the Quadrant for the Tangents

	20	21	22	23	24	
30	3738848	3939104	4142135	4348124	4557164	30
31	3742164	3942465	4145544	4351583	4560778	29
32	3745480	3945826	4148953	4355043	4564293	28
33	3748797	3949188	4152363	4358504	4567809	27
34	3752115	3952551	4155773	4361966	4571326	26
35	3755434	3955915	4159184	4365429	4574843	25
36	3758753	3959280	4162596	4368893	4578361	24
37	3762073	3962646	4166009	4372357	4581880	23
38	3765394	3966012	4169423	4375822	4585400	22
39	3768716	3969379	4172838	4379288	4588921	21
40	3772038	3972746	4176255	4372755	4592443	20
41	3775361	3976114	4189672	4386223	4595966	19
42	3778685	3979483	4183090	4389692	4599490	18
43	3782010	3982853	4186509	4393162	4603015	17
44	3785335	3986224	4189928	4396633	4606541	16
45	3788661	3989596	4193348	4400105	4610068	15
46	3791988	3992969	4196769	4403578	4613596	14
47	3795315	3996342	4200191	4407051	5617125	13
48	3798643	3999716	4203613	4410525	4620654	12
49	3801972	4003090	4207036	4414000	4624184	11
50	3805302	4006465	4210460	4417476	4627715	10
51	3808631	4009841	4213885	4420953	4631247	9
52	3811963	4013217	4217311	4424432	4634780	8
53	3815295	4016594	4220738	4427910	4638314	7
54	3818628	4019972	4224165	4431390	4641849	6
55	3821961	4023351	4227593	4434871	4645385	5
56	2825295	4026731	4231022	4438352	4648922	4
57	3828630	4030112	4234452	4441834	4652460	3
58	3831966	4033494	4237883	4445317	5655099	2
59	3835303	4036877	4241315	4448801	4659540	1
60	3838640	4040262	4244748	4452286	4663081	0
	66	68	67	66	65	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the complements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Tangents.

The degrees of the Quadrant for Tangents.

	25	26	27	28	29	
0	4663081	4877328	5095254	5317094	5543090	60
1	4666623	4880930	5098919	5320826	5546893	59
2	4670166	4884533	5102585	5324559	5550697	58
3	4673710	4888137	5106252	5328293	5554503	57
4	4677 55	4891742	5109920	5332028	5558310	56
5	4680801	4895347	5113589	5335765	5562118	55
6	4684348	4898953	5117259	5339503	5565927	54
7	4687896	4902560	5120930	5343242	5569738	53
8	4691444	4906168	5124602	5346982	5573550	52
9	4694993	4909777	5128275	5350723	5577363	51
10	4698543	4913387	5131949	5354465	5581177	50
11	4702094	4916998	5135625	2358209	5584993	49
12	4705646	4920610	5139302	5361954	5588810	48
13	4709199	4924223	5142980	5365700	5592628	47
14	4712753	4927838	5146659	5369447	5596447	46
15	4716308	4931454	5150339	5373195	5600268	45
16	4719864	4935071	5154020	5376944	5604090	44
17	4723422	4938689	5157702	5380694	5607913	43
18	4726981	4942308	5161385	5384445	5611737	42
19	4730541	4945928	5165069	5388198	5615562	41
20	4734102	4949549	5168755	5391952	5619388	40
21	4737664	4953171	5172442	5395707	5623216	39
22	4741227	4956794	5176130	5399463	5627045	38
23	4744790	4960418	5179819	5403221	5630875	37
24	4748354	4964043	5183509	5406980	5634707	36
25	4751919	4967669	5187200	5410740	5638540	35
26	4755485	4971296	5190892	5414501	5642374	34
27	4759052	4974924	5194585	5418263	5646210	33
28	4762620	4978552	5198279	5422026	5650047	32
29	4766189	4982184	5201974	5425791	5653885	31
30	4769759	4985816	5205670	5429557	5657725	30
	64	63	62	61	60	

The minutes of the degrees of the Quadrant for the Tangents.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arcues of the same Quadrat.

The degrees of the Quadrant for the Tangents

of the Arches of the same Quadrant.

	25	26	27	28	29	
30	4769759	4985816	5205670	5429557	5657725	30
31	4773330	4989448	5209368	5433324	5661566	29
32	4776902	4993081	5213067	5437092	5665408	28
33	4780475	4996716	5216767	5440861	5669251	27
34	4784049	5000352	5220468	5444632	5673096	26
35	4787624	5003989	5224170	5448404	5676942	25
36	4791200	5007627	5227873	5452177	5680789	24
37	4794777	5011266	5231577	5455951	5684637	23
38	4798355	5014906	5235283	5459726	5688486	22
39	4801934	5018547	5238990	5463503	5692337	21
40	4805515	5022189	5242698	5467281	5696189	20
41	4809096	5025832	5246407	5471060	5700043	19
42	4812678	5029476	5250117	5474840	5703898	18
43	4816261	5033121	5253828	5478621	5707754	17
44	4819845	5036767	5257540	5482404	5711611	16
45	4823430	5040414	5261254	5486188	5715469	15
46	4827016	5044062	5264969	5489973	5719329	14
47	4830603	5047712	5268685	5493759	5723190	13
48	4834191	5051363	5272402	5497546	5727052	12
49	4837780	5055015	5276120	5501335	5730916	11
50	4841371	5058668	5279839	5500125	5734781	10
51	4844962	5062322	5283959	5508916	5738647	9
52	4848554	5065977	5287280	5512708	5742515	8
53	4852147	5069633	5291003	5516501	5746384	7
54	4855741	5073290	5294727	5520196	5750254	6
55	4859336	5076948	5298452	5524092	5754125	5
56	4862932	5080607	5302178	5527889	5757998	4
57	4866529	5084267	5205905	5531687	5761872	3
58	4870127	5087928	5309633	5535487	5765747	2
59	4873727	5091590	5313363	5539288	5769624	1
60	4877328	5095254	5317094	5543090	5773502	0
	64	63	62	61	60	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Tangents.

The degrees of the Quadrant for Tangents

	30	31	32	33	34	
0	5773502	6008606	6248693	6494070	6745085	60
1	5777381	6012566	6252738	6498212	6749318	59
2	5781262	6016528	6256785	6502350	6753553	58
3	5785144	6020491	6260834	6506489	6757789	57
4	5789027	6024455	6264884	6510630	6762027	56
5	5792911	6028420	6268935	6514773	6766267	55
6	5796797	6032387	6272988	6518917	6770508	54
7	5800684	6036355	6277042	6523063	6774751	53
8	5804572	6040324	6281098	6527200	6778996	52
9	5808462	6044295	6285155	6531359	6783243	51
10	5812353	6048267	6289214	6535510	6787491	50
11	5816245	6052241	6293274	6539662	6791741	49
12	5820139	6056216	6297336	6543816	6795993	48
13	5824034	6060193	6301399	6547971	6800246	47
14	5827930	6064171	6305464	6552128	6804501	46
15	5831828	6068150	6309530	6556287	6808758	45
16	5835727	6072131	6313598	6560447	6813016	44
17	5839627	6076113	6317667	6564609	6817276	43
18	5843528	6080096	6321738	656877	6821538	42
19	5847431	6084081	6325810	6572937	6825801	41
20	5851335	6088067	6329883	6577103	6830066	40
21	5855241	6092055	6333958	6581271	6834333	39
22	5859148	6096044	6338034	6585440	6838602	38
23	5863056	6100035	6342112	6589611	6842872	37
24	5866966	6104027	6346191	6593784	6847144	36
25	5870877	6108020	6350272	6597958	6851417	35
26	5874489	6112015	6354355	6602134	6855692	34
27	5878702	6116011	6358439	6606312	6859969	33
28	5882617	6120009	6362525	6610491	6864247	32
29	5886533	6124008	6366613	6614672	6868527	31
30	5890450	6128008	6370702	6618855	6872809	30
	59	58	57	56	55	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the complements of the Arches of the same Quadrat.

The degrees of the Quadrant for the Tangents

	30	31	32	33	34	
30	5890450	6128008	6370702	6618855	6872809	30
31	5894369	6132010	6374792	6623039	6877093	29
32	5898289	6136013	6378884	6627225	6881379	28
33	5902211	6140018	6382977	6631413	6885666	27
34	5906134	6144024	6387072	6635603	6889955	26
35	5910058	6148032	6391169	6639792	6894246	25
36	5913984	6152041	6395267	6643984	6898539	24
37	5917911	6156052	6399366	6648178	6902833	23
38	5921839	6160064	6403467	6652373	6907129	22
39	5925769	6164077	6407569	6656570	6911426	21
40	5929700	6168092	6411673	6660768	6915725	20
41	5933633	6172108	6415779	6664968	6920026	19
42	5937567	6176126	6419886	6669170	6924329	18
43	5941502	6180147	6423995	6673373	6928634	17
44	5945438	6184168	6428105	6677578	9932940	16
45	5949376	6188190	6432216	6681785	6937248	15
46	5955315	6192213	6436329	6685994	6941558	14
47	5957255	6196237	6440444	6690204	6945869	13
48	5961197	6200263	6444560	6694416	6950182	12
49	5965140	6204290	6458678	6698630	6954497	11
50	5969084	6208319	6452798	6702845	6958813	10
51	5973030	6212350	6456919	6707062	6963131	9
52	5976776	6216382	6461042	6711281	6967451	8
53	5980926	6220416	6465166	6715501	6971773	7
54	5984876	6224451	6469291	6719723	6976097	6
55	5988827	6228488	6473419	6723946	6980423	5
56	5992780	6232526	6477548	6728171	6984750	4
57	5996734	6246566	6481678	6732397	6989079	3
58	6000690	6240607	6485809	6736625	6993409	2
59	6004647	6244649	6489942	6740854	6997741	1
60	6008606	6248693	6494076	6745085	7002075	0
	59	58	57	56	55	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the complements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Tangents

The degrees of the Quadrant for the Tangents

	35	36	37	38	39	
0	7002075	7265424	7535541	7812856	8097840	60
1	7006411	7269869	7540103	7817542	8102658	59
2	7010749	7274316	7544667	7822230	8107478	58
3	7015088	7278765	7549233	7826920	8112300	57
4	7019429	7283216	7553801	7831612	8117124	56
5	7023772	7287669	7558371	7836306	8121951	55
6	7028117	7292124	7562943	7841002	8126780	54
7	7032463	7296581	7567517	7845700	8131611	53
8	7036811	7301040	7572093	7850400	8136444	52
9	7041161	7305501	7576670	7855102	8141280	51
10	7045513	7309563	7581249	7859807	8146118	50
11	7049867	7314427	7585830	7864514	8150958	49
12	7054223	7318893	7590413	7869223	8155801	48
13	7058581	7323361	7594999	7873934	8160646	47
14	7062940	7327831	7599587	7872647	8165493	46
15	7067301	7332303	7604177	7883363	8170343	45
16	7071664	7336777	7608769	7888081	8175195	44
17	7076029	7341253	7613363	7892801	8180049	43
18	7070395	7345731	7617959	7897523	8184905	42
19	7084763	7350210	7622557	7902247	8189764	41
20	7089133	7354691	7627157	7906973	8194625	40
21	7093505	7359174	7631759	7911702	8199488	39
22	7097879	7363659	7636363	7916433	8204354	38
23	7102254	7368146	7640969	7921166	8209222	37
24	7106631	7372635	7645577	7925901	8214091	36
25	7111010	7377126	7650187	7930638	8218965	35
26	7115391	7381619	7654799	7935378	8223840	34
27	7119773	7386114	7659413	7940120	8228717	33
28	7124167	7390611	7664030	7944864	8233597	32
29	7128543	7395110	7668649	7949610	8238479	31
30	7132931	7399610	7663270	7954358	8243363	30
	54	53	52	51	50	

The degrees of the Quadrant for the Tangents

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the copiements of the Arches of the same Quadrant.

The Table of Tangents.

of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

	35	36	37	38	39	
0	7132931	7399610	7673270	7954358	8243363	30
1	7137321	7404112	7677893	7959109	8248250	29
2	7141713	7408616	7682518	7963862	8253139	28
3	7146106	7413122	7687145	7968617	8258031	27
4	7150501	7417630	7691774	7973374	8262925	26
5	7154898	7422140	7696405	7978133	8267821	25
6	7159297	7426652	7701038	7982895	8272720	24
7	7163698	7431167	7705673	7987659	8277621	23
8	7168100	7435684	7710310	7992425	8282524	22
9	7172504	7440203	7714949	7997193	8287429	21
10	7176910	7444724	7719590	8001963	8292337	20
11	7181318	7449246	7724233	8006736	8297247	19
12	7185728	7453770	7728878	8011511	8302160	18
13	7190140	7458296	7733525	8016288	8307075	17
14	7194554	7462824	7738175	8021067	8311992	16
15	7198970	7467354	7742827	8025849	8316912	15
16	7203387	7471886	7747481	8030633	8321834	14
17	7207806	7476420	7752137	8035419	8326759	13
18	7212227	7480956	7756795	8040207	8331686	12
19	7216650	7485494	7761455	8044997	8336615	11
20	7221075	7490033	7766117	8049790	8341547	10
21	7225502	7494574	7770781	8054585	8346481	9
22	7229931	7499117	7775447	8059382	8351418	8
23	7234362	7503663	7780116	8064181	8356357	7
24	7238794	7508211	7784787	8068983	8361298	6
25	7243228	7512761	7789460	8073787	8366242	5
26	7247664	7517313	7794135	8078593	8371188	4
27	7252102	7521867	7798812	8083401	8376136	3
28	7256541	7526423	7803491	8088212	8381087	2
29	7260982	7530981	7808172	8093025	8386040	1
30	7265424	7535541	7812856	8097840	8390996	0
	54	53	52	51	50	

The minutes of degrees of the Quadrant for the Tangents of the complements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Tangents

The degrees of the Quadrant for the Tangents

	40	41	42	43	44	
0	8390996	8692867	9004040	9325151	9656888	60
1	8395954	8697975	9009308	9330591	9662511	59
2	8400915	8703085	9014579	9336034	9668137	58
3	8405878	8708198	9019853	9341480	9673766	57
4	8410844	8713344	9025130	9346929	9679398	56
5	8415812	8718433	9030410	9352381	9685034	55
6	8420782	8723555	9035693	9357835	9690674	54
7	8425754	8728679	9040978	9363292	9696315	53
8	8430729	8733806	9046266	9368752	9701960	52
9	8435706	8738935	9051557	9374215	9707609	51
10	8440686	8744067	9056850	9379682	9713261	50
11	8445668	8749201	9062146	9385152	9718916	49
12	8450653	8754338	9067445	9390625	9724574	48
13	8455640	8759478	9072747	9396101	9730235	47
14	8460630	8764620	9078052	9401580	9735900	46
15	8465622	8769764	9083360	9407062	9741568	45
16	8470617	8774911	9088670	9412547	9747239	44
17	8475614	8780061	9093983	9418034	9752913	43
18	8480614	8785214	9099299	9423524	9758591	42
19	8485617	8790369	9104618	9429017	9764272	41
20	8490622	8795527	9109940	9434513	9769956	40
21	8495629	8800688	9115265	9440012	9775643	39
22	8500639	8805851	9120593	9445514	9781334	38
23	8505651	8811017	9125923	9451019	9787028	37
24	8510666	8816186	9131256	9456528	9792725	36
25	8515683	8821357	9136592	9462040	9798425	35
26	8520703	8826531	9141930	9467555	9804128	34
27	8525725	8831708	9147271	9473072	9809835	33
28	8530750	8836887	9152615	9478594	9815545	32
29	8535777	8842069	9157962	9484118	9821258	31
30	8540806	8847353	9163312	9489645	9826974	30
	49	48	74	46	45	

The degrees of the Quadrant for the Tangents

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrant.

The Table of Tangents.

of the Arches of the same Quadrant.

	40	41	42	43	44	
30	8540806	8847253	9163312	9489645	9826974	30
31	8545838	8852440	9168665	9495175	9832694	29
32	8550872	8857630	9174021	9500708	9838417	28
33	8555909	8862822	9179380	9506244	9844143	27
34	8560949	8868017	9184741	9511783	9849872	26
35	8565991	8873015	9190105	9517325	9855605	25
36	8571036	8878415	9195472	9522870	9861341	24
37	8576083	8883628	9200842	9528419	9867180	23
38	8581133	8888824	9206215	9533971	9872922	22
39	8586185	8899033	9211590	9539526	9878668	21
40	8591239	8899244	9216968	9545084	9884317	20
41	8596296	8904458	9222349	9550645	9890070	19
42	8601355	8909675	9227733	9556209	9895826	18
43	8606417	8914894	9233120	9561776	9901585	17
44	8611482	8920116	9238510	9567346	9907347	16
45	8616549	8925341	9243903	9572919	9913113	15
46	8621619	8930568	9249299	9578495	9918882	14
47	8626692	8935798	9254698	9584074	9924654	13
48	8631767	8941031	9260100	9589656	9930430	12
49	8636845	8946267	9265505	9595241	9936209	11
50	8641926	8951506	9270913	9600830	9941991	10
51	8647009	8956747	9276324	9606422	9947777	9
52	8652095	8961991	9281738	9612017	9953566	8
53	8657683	8967238	9287155	9617615	9959359	7
54	8662273	8972487	9292574	9623216	9965155	6
55	8667366	8977739	9297996	9628820	9970954	5
56	8672461	8982994	9303421	9634427	9976756	4
57	8677559	8988252	9308849	9640037	9982562	3
58	8682659	8993512	9314280	9645651	9988371	2
59	8687762	8998775	9319714	9651268	9994184	1
60	8692867	9004040	9325151	9656888	10000000	0
	49	48	47	47	45	-

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the complements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Tangents.

The degrees of the Quadrant for the Tangents

	45	46	47	48	
0	10000000	10355302	10723686	11106124	60
1	10005820	10367332	10729942	11112623	59
2	10011643	10367365	10736202	11119126	58
3	10017469	10373402	10742466	11125634	57
4	10023299	10379443	10748734	11132146	56
5	10029132	10385487	10755006	11138662	55
6	10034968	10391535	10761282	11145182	54
7	10040808	10397587	10767562	11151706	53
8	10046651	10403643	10773845	11158235	52
9	10052497	10409702	10780132	11164768	51
10	10058347	10415765	10786423	11171305	50
11	10064201	10421832	10792718	11177846	49
12	10070058	10427902	10799017	11184392	48
13	10075918	10433976	10805320	11190942	47
14	10081782	10340054	10811627	11197496	46
15	10087649	10446135	10817938	11204054	45
16	10093520	10452220	10824253	11210617	44
17	10099394	10458309	10830572	11217184	43
18	10105272	10464401	10836895	11223755	42
19	10111153	10470497	10843222	11230330	41
20	10117038	10476597	10849554	11236910	40
21	10122926	10482701	10855889	11243494	39
22	10128818	10488808	10862228	11250082	38
23	10134713	10494919	10868571	11256675	37
24	10140611	10501034	10874918	11263272	36
25	10146513	10507153	10881269	11269873	35
26	10152418	10513275	10887624	11276478	34
27	10158327	10519401	10893983	11283088	33
28	10164239	10525531	10900346	11289702	32
29	10170154	10531664	10906713	11296321	31
30	10176073	10537801	10913084	11302944	30
	44	43	42	41	

The degrees of the Quadrant for the Tangents

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrãt.

The Table of Tangents.

of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

	45	46	47	48	
30	10176073	10537800	10913084	11302944	30
31	10181996	10543942	10919459	11309571	29
32	10187922	10550087	10925838	11316203	28
33	10193852	10556235	10932221	11322899	27
34	10199785	10562387	10938608	11329480	26
35	10205722	10568543	10945000	11336125	25
36	10211663	10574703	10951396	11342774	24
37	10217607	10580867	10957796	11349428	23
38	10223555	10587034	10964200	11356086	22
39	10229506	10593205	10970608	11362748	21
40	10235460	10599280	10977020	11369415	20
41	10241418	10605559	10983436	11376086	19
42	10247380	10611742	10989856	11382762	18
43	10253345	10617929	10996280	11389442	17
44	10259314	10624119	11002708	11396126	16
45	10265286	10630313	11009140	11402815	15
46	10271262	10636511	11015577	11409508	14
47	10277242	10642713	11022028	11416206	13
48	10283225	10648919	11028463	11422908	12
49	10289212	10655128	11034912	11429615	11
50	10295202	10661341	11041365	11436326	10
51	10301196	10667558	11047832	11443042	9
52	10307193	10673779	11054283	11449762	8
53	10313194	10680004	11060748	11456487	7
54	10319199	10686233	11067218	11463216	6
55	10325207	10692466	11073692	11469950	5
56	10331219	10698702	11080170	11476688	4
57	10337234	10704942	11086652	11483431	3
58	10343253	10711186	11093138	11490178	2
59	10349276	10717434	11099629	11496929	1
60	10355302	10723686	11106124	11503684	0
	44	43	42	41	

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Tangents.

The degrees of the Quadrant for the Tangents

	49	50	51	52	
0	11503684	11917537	12348972	12799416	60
1	11510444	11924580	12356320	12807093	59
2	11517208	11931628	12363673	12814776	58
3	11523977	11938680	12371032	12822465	57
4	11530751	11945737	12378394	12830159	56
5	11537529	11952799	12385762	12837859	55
6	11544312	11959866	12393136	12845565	54
7	11551100	11966938	12400515	12853277	53
8	11557893	11974015	12407999	12860994	52
9	11564691	11981097	12415288	12868717	51
10	11571494	11988183	12422683	12876445	50
11	11578301	11995274	12430083	12884179	49
12	11585112	12002370	12437489	12891919	48
13	11591928	12009471	12444900	12899665	47
14	11598748	12016578	12452317	12907417	46
15	11605572	12023690	12459739	12915175	45
16	11612401	12030807	12467167	12922939	44
17	11619234	12037929	12474600	12930709	43
18	11626072	12045056	12482039	12938485	42
19	11632915	12052188	12489484	12946267	41
20	11639763	12059325	12496934	12954055	40
21	11646615	12066467	12504389	12961848	39
22	11653472	12073614	12511850	12969647	38
23	11660334	12080766	12519316	12977457	37
24	11667200	12087923	12526787	12985263	36
25	11674071	12095085	12534264	12993080	35
26	11680947	12102252	12541746	13000903	34
27	11687827	12109424	12549233	13008732	33
28	11694712	12116601	12556725	13016567	32
29	11701602	12123783	12564222	13024407	31
30	11708497	12130970	12571724	13032253	30
	40	39	38	37	

The degrees of the Quadrant for the Tangents

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrant.

◗	49	50	51	52	
30	11708497	12130970	12571724	13032253	30
31	11715396	12138162	12579232	13040105	29
32	11722300	12145355	12586746	13047963	28
33	11729208	12152561	12594265	13055827	27
34	11736121	12159768	12601790	13063697	26
35	11743039	12166981	12609321	13071573	25
36	11749962	12174199	12616858	13079455	24
37	11756989	12181422	12624400	13087343	23
38	11763821	12188650	12631948	13095237	22
39	11770758	12195883	12639501	13103138	21
40	11777700	12203121	12647060	13111045	20
41	11784646	12210364	12654624	13118958	19
42	11791597	12217613	12662194	13126877	18
43	11798553	12224867	12669769	13134802	17
44	11805514	12232126	12677350	13142732	16
45	11812479	12239390	12684937	13150668	15
46	11819449	12246659	12692530	13158610	14
47	11826424	12253933	12700128	13166558	13
48	11833404	12261212	12707732	13174512	12
49	11840388	12268496	12715341	13182472	11
50	11847377	12275786	12722956	13190438	10
51	11854371	12283081	12730577	13198411	9
52	11861370	12290381	12738203	13206390	8
53	11868374	12297687	12745835	13214375	7
54	11875383	12304998	12753473	13222367	6
55	11882397	12312314	12761116	13230365	5
56	11889417	12319635	12768765	13238369	4
57	11896438	12326961	12776420	13246379	3
58	11903466	12334293	12784080	13254396	2
59	11910499	12341630	12791745	13262419	1
60	11917537	12348972	12799416	13270448	0
◖	40	39	38	37	

of the complements of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrat.

The Table of Tangents.

The degrees of the Quadrant for the Tangents

	53	54	55	56	
0	13270448	13763820	14281480	14825610	60
1	13278483	13772243	14290325	14834916	59
2	13286524	13780673	14299177	14844230	58
3	13294571	13789109	14308037	14853553	57
4	13302624	13797552	14316905	14862884	56
5	13310683	13806002	14325780	14872223	55
6	13318749	13814459	14334662	14881570	54
7	13326821	13822922	14343552	14890925	53
8	13334899	13831392	14352451	14900288	52
9	13342984	13839869	14361354	14909659	51
10	13351075	13848352	14370266	14919038	50
11	13359172	13856842	14379186	14928426	49
12	13367276	13865339	14388113	14937822	48
13	13375386	13873843	14397048	14947226	47
14	13383502	13882354	14405990	14956638	46
15	13391624	13890872	14414939	14966058	45
16	13399753	13899397	14423896	14975486	44
17	13407888	13907930	14432861	14984923	43
18	13416029	13916470	14441833	14994368	42
19	13424177	13925017	14450812	15003821	41
20	13432331	13933571	14459799	15013283	40
21	13440492	13942131	14468794	15022753	39
22	13448659	13950698	14477797	15032231	38
23	13456832	13959272	14486807	15041717	37
24	13465011	13967853	14495825	15051211	36
25	13473197	13976441	14504850	15060714	35
26	13481390	13985035	14513883	15070225	34
27	13489589	13993636	14522924	15079744	33
28	13497794	14002244	14531972	15089271	32
29	13506006	14010859	14541028	15078807	31
30	13514224	1401948	14550091	15108351	30
	36	35	34	33	

The degrees of the Quadrant for the Tangents

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrant.

of the Arches of the same Quadrant.

	53	54	55	56	
30	13514224	14019481	14550091	15108351	30
31	13522449	14028110	14559162	15117903	29
32	13530689	14036746	14568241	15127464	28
33	13538918	14045389	14577327	15137034	27
34	13547162	14054040	14586421	15146612	26
35	13555413	14062698	14595523	15156199	25
36	13563670	14071363	14604633	15165794	24
37	13571834	14080035	14613750	15175398	23
38	13580104	14088715	14622875	15185011	22
39	13588381	14097402	14632007	15194632	21
40	13596764	14106097	14641146	15204261	20
41	13605054	14114798	14650293	15213899	19
42	13613350	14123506	14659449	15223545	18
43	13621653	14132221	14668613	15233200	17
44	13629963	14140923	14677785	15242863	16
45	13638279	14149672	14686965	15252535	15
46	13646602	14158409	14696153	15262216	14
47	13654932	14167153	14705349	15271905	13
48	13663268	14175904	14714553	15281603	12
49	13671610	14184663	14723765	15291309	11
50	13679959	14193429	14732985	15301024	10
51	13688315	14202202	14742212	15310748	9
52	13696677	14210982	14751447	15320481	8
53	13705046	14219769	14760690	15330222	7
54	13713422	14228563	14769941	15339972	6
55	13721805	14237365	14779200	15349730	5
56	13730194	14246174	14788466	15359497	4
57	13738590	14254990	14797740	15369273	3
58	13746993	14263813	14807022	15379057	2
59	13755403	14272643	14816312	15388850	1
60	13763820	14281480	14825610	15398651	0
	36	35	36	33	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

of the complements of the Arches of the same Quadrant.

The Table of Tangents.

The degrees of the Quadrant for the Tangents.

	57	58	59	60	
0	15398651	16003347	16642794	17320508	60
1	15408461	16013710	16653766	17332150	59
2	15418280	16024083	16664749	17343804	58
3	15428108	16034466	16675742	17355469	57
4	15437945	16044859	16686746	17367146	56
5	15447791	16055261	16697760	17378834	55
6	15457646	16065673	16708785	17390534	54
7	15467510	16076095	16719820	17402246	53
8	15477382	16086527	16730866	17413969	52
9	15487263	16096968	16741922	17425704	51
10	15497153	16107419	16752989	17437451	50
11	15507052	16117880	16764067	17449210	49
12	15516960	16128351	16775156	17460981	48
13	15526877	16138832	16786256	17472764	47
14	15536803	16149322	16797367	17484559	46
15	15546738	16159822	16808489	17496366	45
16	15556682	16170332	16819621	17508185	44
17	15566636	16180852	16830764	17520026	43
18	15576599	16191381	16841918	17531869	42
19	15586571	16201920	16853083	17543724	41
20	15596552	16212469	16864259	17555591	40
21	15606542	16224028	16875446	17567470	39
22	15616541	16233597	16886644	17579362	38
23	15626549	16244176	16897853	17591266	37
24	15636566	16254766	16909074	17603182	36
25	15646592	16265366	16920306	17615111	35
26	15656627	16275976	16931549	17627052	34
27	15666671	16286596	16942803	17639006	33
28	15676724	16297226	16954068	17650972	32
29	15686786	16307866	16965344	17662951	31
30	15696857	16318516	16976631	17674941	30
	32	31	30	29	

The degrees of the Quadrant for the Tangents

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrãt.

	57	58	59	60	
30	15696857	16318516	16976631	17674941	30
31	15706938	16329176	16987929	17686945	29
32	15717028	16339847	16999239	17698960	28
33	15727127	16350528	17010560	17710987	27
34	15737235	16361219	17021892	17723027	26
35	15747353	16371920	17033236	17735079	25
36	15757480	16382631	17044591	17747143	24
37	15767616	16395352	17055957	17759220	23
38	15777761	16404083	17067325	17771309	22
39	15787915	16414824	17078714	17783410	21
40	15798078	16425575	17090115	17795524	20
41	15808251	16436337	17101527	17808651	19
42	15818433	16447109	17112950	17819790	18
43	15828625	16457892	17124384	17831942	17
44	15838827	16468685	17135829	17844107	16
45	15849038	16479488	17147285	17856285	15
46	15859259	16490302	17158752	17868475	14
47	15869489	16501126	17170231	17880678	13
48	15879729	16511960	17181721	17892894	12
49	15889979	16522805	17193222	17905123	11
50	15900238	16533660	17204734	17917364	10
51	15910507	16544526	17216258	17929618	9
52	15920785	16555402	17227794	17941885	8
53	15931073	16566289	17239342	17954164	7
54	15941370	16577186	17250902	17966456	6
55	15951676	16588094	17262473	17978761	5
56	15961992	16599013	17274056	17991079	4
57	15972317	16609942	17285651	18003410	3
58	15982651	16620882	17297258	18015753	2
59	15992994	16631833	17308877	18028109	1
60	16003347	16642794	17320508	18040478	0
	32	31	30	29	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrãt.

of the complements of the Arches of the same Quadrant

The Table of Tangents.

The degrees of the Quadrant for the Tangents.

	61	62	63	64	
0	18040478	18807265	19626104	20503034	60
1	18052860	18820471	19640225	20518180	59
2	18065255	18833691	19654362	20533344	58
3	18077663	18846925	19668510	20548526	57
4	18090084	18860174	19682680	20563726	56
5	18102518	18873437	19696874	20578945	55
6	18114966	18886715	19711074	20594182	54
7	18127427	18900007	19725293	20609437	53
8	18139901	18913314	19739528	20624711	52
9	18152388	18926636	19753780	20640003	51
10	18164889	18939972	19768048	20655313	50
11	18177403	18953323	19782333	20670642	49
12	18189930	18966689	19796634	20685989	48
13	18202470	18980070	19810951	20701355	47
14	18215024	18993466	19825285	20716739	46
15	18227591	19006876	19839635	20732142	45
16	18240171	19020301	19854002	20747564	44
17	18252765	19033741	19868386	20763004	43
18	18265372	19047196	19882786	20778463	42
19	18277992	19060665	19897203	20793941	41
20	18290626	19074149	19911637	20809438	40
21	18303273	19087648	19926088	20824953	39
22	18315934	19101162	19940555	20840487	38
23	18328608	19114691	19955039	20856040	37
24	18341296	19128235	19969540	20871612	36
25	18353997	19141795	19984057	20887202	35
26	18366712	19155370	19998591	20902811	34
27	18379440	19168960	20013142	20918439	33
28	18392182	19182565	20027709	20934086	32
29	18404938	19196185	20042297	20949752	31
30	18417707	19209821	20056898	20965436	30
	28	27	27	25	

The degrees of the Quadrant for the Tangents

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrãt.

	61	62	63	64	
30	18417707	19209821	20056898	20965436	30
31	18430490	19223472	20071516	20981140	29
32	18443287	19237138	20086152	20996863	28
33	18456098	19250819	20100805	21012605	27
34	18468921	19264516	20115475	21028367	26
35	18481760	19278228	20130163	21044148	25
36	18494612	19291955	20144868	21059949	24
37	18507478	19305698	20159590	21075769	23
38	18520357	19319456	20174329	21091609	22
39	18533250	19333230	20189086	21107468	21
40	18546157	19347019	20203860	21123347	20
41	18559078	19360824	20218651	21139246	19
42	18572013	19374644	20233460	21155164	18
43	18584962	19388480	20248286	21172102	17
44	18597925	19402331	20263130	21187059	16
45	18610902	19416198	20277991	21203036	15
46	18623894	19430081	20292870	21219032	14
47	18636900	19443980	20307767	21235048	13
48	18649920	19457894	20322681	21251083	12
49	18662954	19471824	20337613	21267138	11
50	18676002	19485770	20352563	21283213	10
51	18689064	19499732	20367531	21299308	9
52	18702140	19513710	20382516	21315423	8
53	18715231	19527704	20397519	21331558	7
54	18728335	19541714	20412539	21347713	6
55	18741454	19555739	20427577	21363888	5
56	18754587	19569780	20442633	21380083	4
57	18767735	19583837	20457706	21396298	3
58	18780897	19597910	20472797	21412534	2
59	18794074	19611999	20487906	21428790	1
60	18807265	19626104	20503034	21445067	0
	28	27	26	25	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrãt.

of the complements of the Arches of the same Quadrant

The Table of Tangents.

The degrees of the Quadrant for the Tangents

	65	66	67	68	
0	21445067	22460371	23558529	24750869	60
1	21461364	22477965	23577595	24771613	59
2	21477681	22495582	23596687	24792387	58
3	21494019	22513222	23615805	24813191	57
4	21510377	22530885	23634950	24834024	56
5	21526756	22548571	23654121	24854887	55
6	21543155	22566281	23673318	24875780	54
7	21559575	22584014	23692542	24896704	53
8	21576015	22601771	23711793	24917659	52
9	21592475	22619951	23731071	24938644	51
10	21608956	22637355	23750375	24959659	50
11	21625458	22655183	23769706	24980705	49
12	21641981	22673034	23789064	25001782	48
13	21658525	22690909	23808448	25022890	47
14	21675090	22708808	23827859	25044029	46
15	21691676	22726730	23847297	25065198	45
16	21708283	22744676	23866762	25086398	44
17	21724911	22762646	23886254	25107629	43
18	21741559	22780639	23905773	25128991	42
19	21758228	22798656	23925320	25150183	41
20	21774918	22816696	23944895	25171506	40
21	21791629	22834760	23964496	25192861	9
22	21808362	22852848	23984124	25214248	38
23	21825116	22870960	24003779	25235666	37
24	21841892	22889096	24023462	25257116	36
25	21858689	22907256	24043172	25278597	35
26	21875508	22925441	24062910	25300115	34
27	21892348	22943650	24082675	25321655	33
28	21909210	22961883	24102468	25343231	32
29	21926094	22980141	24122289	25364841	31
30	21943000	22998424	24142137	25386482	30
	24	23	22	21	

The degrees of the Quadrant for the Tangents

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrat.

The Table of Tangents.

of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

	65	66	67	68	
30	21944000	22998424	24142137	25386482	30
31	21959926	23016731	24162013	25408154	29
32	21976874	23035062	24181917	25429858	28
33	21993843	23053418	24201849	25451594	27
34	22010834	23071798	24221809	25473362	26
35	22027846	23090203	24241798	25495162	25
36	22044879	23108632	24261815	25516995	24
37	22061934	23127086	24281860	25538863	23
38	22079011	23145565	24301934	25560758	22
39	22096109	23164068	24322037	25582688	21
40	22113229	23182597	24342169	25604651	20
41	22130372	23201151	24362329	25626647	19
42	22147537	23219730	24382518	25648675	18
43	22164725	23238335	24402735	25670736	17
44	22181935	23256965	24422981	25692830	16
45	22199168	23275621	24443256	25714957	15
46	22216424	23294302	24463555	25737218	14
47	22233703	23313008	24483891	25759312	13
48	22251004	23331740	24504252	25781540	12
49	22268328	23350498	24524641	25803801	11
50	22285675	23369284	24545061	25826096	10
51	22303044	23388092	24565509	25848424	9
52	22320435	23406927	24585986	25870786	8
53	22337848	23425788	24606491	25893181	7
54	22355284	23444674	24627028	25915610	6
55	22372742	23463586	24647594	25938073	5
56	22390223	23482523	24668189	25960569	4
57	22407726	23501486	24688814	25983099	3
58	22425252	23520475	24709469	26005663	2
59	22442800	23539489	24730154	26028261	1
60	22460371	23558529	24750869	26050893	0
	24	23	22	21	

The minutes of degrees of the Quadrant for the Tangents of the complements of the Arches of the same Quadrat.

of the complements of the Arches of the same Quadrant.

The Table of Tangents.

The degrees of the Quadrant for Tangents

	69	70	71	72	
0	26050893	27474777	29042105	30776834	60
1	26073559	27499665	29069569	30807323	59
2	26096260	27524592	29097080	30837866	58
3	26118996	27549559	29124638	30868465	57
4	26141766	27574565	29152243	30890119	56
5	26164573	27599612	29179895	30929828	55
6	26187411	27624699	29207595	30960593	54
7	26210286	27649827	29235343	30991413	53
8	26233196	27674995	29263139	31022289	52
9	26256141	27700204	29290382	31053221	51
10	26279120	27725453	29318873	31084208	50
11	26302135	27750742	29346811	31115252	49
12	26325185	27776072	29374797	31146352	48
13	26348270	27802443	29402831	31177508	47
14	26371390	27826855	29430913	31208720	46
15	26394546	27852308	29459043	31239989	45
16	26417738	27877803	29487221	31271315	44
17	26440966	27903339	29515446	31302698	43
18	26464229	27928917	29543719	31334138	42
19	26487528	27954536	29572041	31365636	41
20	26510863	27980196	29600411	31397191	40
21	26534234	28005898	29628831	31428805	39
22	26557641	28031642	29657301	31460476	38
23	26581084	28057429	29685820	31492205	37
24	26604563	28083258	29714388	31523992	36
25	26628079	28109129	29743006	31555838	35
26	26651631	28135043	29771674	31587742	34
27	26675220	28160999	29800392	31619705	33
28	26698845	28186998	29829160	31651727	32
29	26722507	28213040	29857978	31683807	31
30	26746206	28239125	29886847	31715946	30
	20	19	18	17	

The degrees of the Quadrant for the Tangents

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrãt.

of the Arches of the same Quadrant.

	69	70	71	72	
30	26746206	28239125	29886847	31715946	30
31	26769942	28265253	29915765	31748144	29
32	26793716	28291424	29944734	31780401	28
33	26816527	28317638	29973753	31812717	27
34	26841375	28343895	30002823	31845093	26
35	26865260	28379195	30031943	31877528	25
36	26889183	28396539	30061113	31910324	24
37	26913143	28422926	30090334	31942580	23
38	26937141	28449357	30119605	31975197	22
39	26961177	28475832	30148927	32007875	21
40	26985251	28502350	30178299	32040613	20
41	27009362	28528913	30207723	32073413	19
42	27033511	28555520	30237200	32106275	18
43	27057698	28582172	30266730	32139200	17
44	27081922	28608868	30296312	32172187	16
45	27106184	28635608	30325947	32205237	15
46	27130484	28662393	30355635	32238349	14
47	27154823	28689223	30385375	32271524	13
48	27179200	28716096	30415169	32304762	12
49	27203616	28743015	30445015	32338064	11
50	27228070	28769979	30474915	32371430	10
51	27252563	28796987	30504867	32404858	9
52	27272695	28824040	30534871	32438348	8
53	27301667	28851139	30564930	32471901	7
54	27326278	28878283	30595041	32505517	6
55	27350929	28905472	30625205	32539196	5
56	27375620	28932707	30655423	32572937	4
57	27400350	28959988	30685695	32606741	3
58	27425120	28987315	30716020	32640907	2
59	27449929	29014687	30746400	32674536	1
60	27474777	29042105	30776834	32708528	0
	20	19	18	17	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrãt.

of the complements of the Arches of the same Quadrant.

The Table of Tangents.

The degrees of the Quadrant for Tangents

	73	74	75	76	
0	32708528	34874151	37320517	40107808	60
1	32745286	34912477	37363987	40157569	59
2	32776709	34950881	37407551	40207446	58
3	32810898	34989364	37451210	40257440	57
4	32845152	35027925	37494964	40307552	56
5	32879757	35066565	37538814	40357781	55
6	32913862	35105283	37582760	40408129	54
7	32948317	35144080	37626803	40458596	53
8	32982839	35182956	37670943	40509183	52
9	33017427	35221911	37715180	40559890	51
10	33052082	35260945	37759515	40610718	50
11	33086802	35300059	37803948	40661665	49
12	33121588	35349253	37848479	40712731	48
13	33156441	35378528	37893109	40763917	47
14	33191362	35417883	37937838	40815224	46
15	33226351	35457320	37982666	40866652	45
16	33261408	35496838	38027592	40918201	44
17	33296534	35536438	38072616	40969871	43
18	33331728	35576121	38117740	41021663	42
19	33366990	35615888	38162963	41073577	41
20	33402321	35655739	38208285	41125614	40
21	33437720	35695672	38253708	41177775	39
22	33473188	35735689	38299232	41230062	38
23	33508725	35775789	38344857	41282475	37
24	33544330	35815973	38390584	41335015	36
25	33580005	35856241	38436414	41387683	35
26	33615750	35896593	38482347	41440480	34
27	33651566	35937029	38528384	41493407	33
28	33687453	35977550	38574525	41546464	32
29	33723410	36018156	38620772	41599653	31
30	33759438	36058848	38667125	41652974	30
	16	15	14	12	

The degrees of the Quadrant for the Tangents

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrãt.

The Table of Tangents.

of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

	73	74	75	76	
30	33759438	36058848	38667125	41652974	30
31	33795535	36099623	38713580	41706424	29
32	33831703	36140483	38760139	41760003	28
33	33867942	36181427	38806801	41813712	27
34	33904252	36222456	38853567	41867550	26
35	33940634	36263570	38900438	41921518	25
36	33977088	36304771	38947416	41975617	24
37	34013615	36346060	38994501	42029848	23
38	34050215	36387437	39041695	42084211	22
39	34086888	36428903	39088998	42138706	21
40	34123634	36470459	39136409	42193334	20
41	34160453	36512103	39183929	42248096	19
42	34197345	36553836	39231557	42302993	18
43	34234310	36595659	39279294	42358025	17
44	34271348	36637572	39327139	42413193	16
45	34308459	36679574	39375094	42468497	15
46	34345644	36721666	39422158	42523937	14
47	34382903	36763849	39471331	42579514	13
48	34420237	36806121	39519614	42635228	12
49	34457647	36848483	39568006	42691080	11
50	34495132	36890936	39616509	42747070	10
51	34532692	36933479	39665124	42803199	9
52	34570327	36976114	39713852	42859468	8
53	34608038	37018840	39762695	42915878	7
54	34645824	37061659	39811654	42972429	6
55	34683686	37104570	39860729	43029122	5
56	34721625	37147574	39909917	43085958	4
57	34759640	37190670	39959218	43142937	3
58	34797733	37233859	40008633	43200060	2
59	34835903	37277141	40058103	43257328	1
60	34874151	37320517	40107808	43314742	0
	16	15	14	13	

The minutes of degrees of the Quadrant for the Tangents of the complements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Tangents.

The degrees of the Quadrant for the Tangents.

	77	78	79	80	
0	43314742	47046295	51445543	56712854	60
1	43372301	47113680	51525561	56809480	59
2	43430006	47181249	51605820	56906425	58
3	43487857	47249003	51686321	57003690	57
4	43545855	47316942	51767065	57101277	56
5	43604000	47385067	51848053	57199188	55
6	43662293	47453380	51929285	57297425	54
7	43720733	47521882	52010762	57395990	53
8	43779321	47590575	52092485	57494885	52
9	43838057	47659460	52174455	57594111	51
10	43896942	47728538	52256673	57693670	50
11	43955977	47797809	52339140	57793564	49
12	44015163	47867274	52421857	57893795	48
13	44074501	47936934	52504826	57994366	47
14	44133992	48006790	52588048	58095279	46
15	44193637	48076841	52671525	58196536	45
16	44253435	48147088	52755259	58298138	44
17	44313387	48217531	52839251	58400087	43
18	44373494	48288171	52923503	58502385	42
19	44433756	48359008	53008016	58605934	41
20	44494174	48430043	53092792	58708035	40
21	44554749	48501278	53177831	58811388	39
22	44615481	48572714	53263134	58915095	38
23	44676371	48644352	53348702	59019157	37
24	44737419	48716193	53434536	59123576	36
25	44798626	48788238	53520637	59228353	35
26	44859993	48860488	53607006	59333490	34
27	44921521	48932945	53693644	59438989	33
28	44983211	49005610	53780552	59544852	32
29	45045065	49078483	53867731	59651081	31
30	45107083	49151565	53955183	59757678	30
	12	11	10	9	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrãt.

The degrees of the Quadrant for the Tangents

	77	78	79	80	
30	45107083	49151565	53955183	59757678	30
31	45169263	49224856	54042909	59864646	29
32	45231607	49298357	54130911	59971987	28
33	45294114	49372069	54219190	60079703	27
34	45356785	49445993	54307748	60187796	26
35	45419621	49520130	54396586	60296268	25
36	45482623	49594481	54485705	60405121	24
37	45545790	49669047	54575107	60514358	23
38	45609123	49743829	54664793	60623981	22
39	45672623	49818827	54754764	60733992	21
40	45736291	49894042	54845022	60844392	20
41	45800128	49969475	54935569	60955184	19
42	45864135	50045127	55029406	61066370	18
43	45928314	50120999	55117535	61177952	17
44	45992666	50197092	55208958	61289930	16
45	46057192	50273407	55300676	61402307	15
46	46121892	50349935	55392692	61515085	14
47	46186767	50246707	55485007	61628267	13
48	46251817	50503605	55577622	61741856	12
49	46318043	50580910	55670539	61855854	11
50	46382445	50658353	55763759	61970263	10
51	46448023	50736025	55857283	62085085	9
52	46513778	50813927	55951112	62200323	8
53	46579711	50892060	56045247	62315979	7
54	46645823	50970425	56139689	62432056	6
55	46712115	51049023	56234439	62548556	5
56	46778587	51127855	56329498	62665481	4
57	46845240	51206922	56424868	62782833	3
58	46912075	51286225	56520550	62900615	2
59	46979093	51365765	56616545	63018829	1
60	47046295	51445543	56712854	63137478	0
	12	11	10	9	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Tangents.

The degrees of the Quadrant for the Tangents

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

	81	82	83	84	
0	63137478	71153707	81443502	95143611	60
1	63256564	71304198	81639821	95410585	59
2	63376089	71455313	81837074	95679034	58
3	63496056	71607058	82035268	95948971	57
4	63616468	71759440	82234410	96220411	56
5	63737327	71912459	82434508	96493467	55
6	63858635	72066117	82635570	96767939	54
7	63980394	72220422	82837603	97044063	53
8	64102607	72375376	83040614	97321646	52
9	64225276	72530983	83244610	97600890	51
10	64348404	72687247	83449598	97881716	50
11	64471994	72844173	83655585	98164135	49
12	64596049	73001766	83862572	98448162	48
13	64720571	73160031	84070565	98733810	47
14	64845563	73318972	84279571	99021104	46
15	64971028	73478593	84489598	99310047	45
16	65096969	73638898	84700687	99600655	44
17	65223388	73799892	84912817	99893042	43
18	65350287	73961579	85125995	100187022	42
19	65477669	74123964	85340229	100482822	41
20	65605537	74287052	85555525	100780346	40
21	65733894	74450847	85771891	101079507	39
22	65862743	74615354	85989335	101380525	38
23	65992087	74780577	86207866	101683314	37
24	66121928	74946521	86427493	101987889	36
25	66252268	75113189	86648225	102294266	35
26	66383110	75280586	86870072	102602473	34
27	66514457	75448716	87093043	102912514	33
28	66646313	75617584	87317150	103224405	32
29	66778681	75787195	87542404	103538166	31
30	66911564	75957554	87768816	103853919	30
	8	7	6	5	

The degrees of the Quadrant for the Tangents

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrant.

	81	82	83	84	
30	66911564	75957554	87768816	103853919	30
31	67044965	76128666	87996394	104171468	29
32	67178887	76300536	88225146	104491055	28
33	67313334	76473170	88455079	104812581	27
34	67448309	76646573	88686196	105136063	26
35	67583815	76820751	88918508	105461519	25
36	67719855	76995710	89152021	105788969	24
37	67856423	77171455	89386745	106118428	23
38	67993549	77347991	89622688	106449917	22
39	68131209	77525324	89859858	106783466	21
40	68269416	77703459	90098268	107119198	20
41	68408173	77882402	90337927	107456902	19
42	68547138	78062159	90578848	107796712	18
43	68687350	78242737	90821043	108138767	17
44	68827777	78424142	91064526	108482852	16
45	68968769	78606379	91309309	108829233	15
46	69110326	78789454	91555401	109177805	14
47	69252455	78973371	91802810	109528589	13
48	69395158	79158136	92051546	109881598	12
49	69538439	79343754	92301618	110236864	11
50	69682302	79530231	92553036	110594415	10
51	69826751	79717572	92805759	110954264	9
52	69971789	79905783	93059875	111316432	8
53	70117419	80094869	93315361	111680940	7
54	70263645	80284835	93572238	112047814	6
55	70410470	80475688	93830595	112417202	5
56	70557898	80667435	94090270	112788878	4
57	70705932	80860083	94351448	113163656	3
58	70854576	81053639	94614055	113539681	2
59	71003833	81248110	94878103	113918875	1
60	71153706	81443502	95143611	114300579	0
	8	7	6	5	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrãt.

of the complements of the Arches of the same Quadrant.

The Table of Tangents.

The degrees of the Quadrant for the Tangents

	85	86	87	
0	11430057 9	14300660 1	19081120 0	60
1	11468481 9	14360694 3	19187916 3	59
2	11507161 9	14421230 7	19295909 5	58
3	11546100 5	14482275 7	19405120 0	57
4	11585301 7	14543835 8	19515568 5	56
5	11624766 8	14605917 5	19627314 6	55
6	11664498 5	14668527 5	19740305 4	54
7	11704499 5	14731672 6	19854599 3	53
8	11744786 4	14795361 1	19970219 1	52
9	11785334 6	14859598 7	20087187 8	51
10	11826175 7	14924414 8	20205570 5	50
11	11867283 4	14989775 3	20325309 3	49
12	11908689 0	15055723 3	20446472 6	48
13	11950366 9	15122230 1	20569126 0	47
14	11992348 8	15189346 2	20693211 1	46
15	12034623 3	15257058 1	20818840 2	45
16	12077193 7	15325348 7	20945954 5	44
17	12120064 3	15394272 9	21074669 3	43
18	12163237 0	15463815 8	21204927 1	42
19	12206715 1	15533985 5	21336821 4	41
20	12250501 7	15604792 3	21470408 5	40
21	12294600 3	15676243 3	21605602 2	39
22	12339014 2	15748347 4	21742550 7	38
23	12383763 4	15821113 6	21881240 5	37
24	12428819 5	15894550 9	22021704 9	36
25	12474216 9	15968675 3	22163978 4	35
26	12519928 0	16043477 0	22308098 3	34
27	12565987 8	16118984 9	22454098 7	33
28	12612384 2	16195230 5	22602016 7	32
29	12659121 1	16272169 8	22751890 2	31
30	12706203 6	16349866 0	22903758 4	30
	4	3	2	

The degrees of the Quadrant for the Tangents

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrãt.

	85	86	87	
30	127062036	163498660	229037584	30
31	127536341	164282764	230576614	29
32	128014165	165074651	232136427	28
33	128495548	165873906	233717425	27
34	128980531	166681172	235320041	26
35	129469305	167496287	236945285	25
36	129961652	168319085	238592501	24
37	130457692	169150247	240262714	23
38	130957670	169989613	241957021	22
39	131461286	170837304	243674732	21
40	131968930	171693461	245417543	20
41	132480297	172558198	247184785	19
42	132995769	173431641	248978216	18
43	133515636	174313925	250797165	17
44	134038804	175205183	252643455	16
45	134566419	176105555	254517088	15
46	135098153	177015180	256417991	14
47	135634096	177934219	258348100	13
48	136174272	178862806	260 07416	12
49	136718731	179801085	262296605	11
50	137267523	180749537	264316358	10
51	137820702	181707670	266366704	9
52	138378319	182676299	268449755	8
53	138940429	183654941	270565570	7
54	139507087	184644417	272714927	6
55	140078545	185644562	274898633	5
56	140654481	186655202	277117516	4
57	141235334	187677207	279372435	3
58	141820765	188710414	281664304	2
59	142411234	189755028	283994009	1
60	143006601	190811200	286362498	0
	4	3	2	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the complements of the Arches of the same Quadrāt.

of the complements of the Arches of the same Quadrant

The Table of Tangents.

The degrees of the Quadrant for the Tangents.

	88		89	
0	286362498		572899830	60
1	288770746		582610421	59
2	291219764		592655713	58
3	293710598		603057015	57
4	296244357		613825994	56
5	298823024		624990311	55
6	301445987		636564040	54
7	304115322		648591509	53
8	306833212		661050728	52
9	309599077		674016435	51
10	312416191		687500725	50
11	315283945		701531474	49
12	318204757		716149676	48
13	321181137		731385593	47
14	324212583		747289264	46
15	327302782		763899813	45
16	330451272		781259259	44
17	333661982		799432199	43
18	336934467		818463792	42
19	340272744		838430438	41
20	334677949		859395374	40
21	347150587		881427652	39
22	350695255		904627361	38
23	3543 12962		9290 81086	37
24	3580c6024		954893332	36
25	361776788		982180553	35
26	365626388		1011062679	34
27	369560062		1041705454	33
28	373579199		1074263399	32
29	377686614		1108922084	31
30	381885288		1145891136	30
	I		O	

The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrãt.

The degrees of the Quadrant for the Tangents

of the Arches of the same Quadrant.

	88		89	
30	381885288		1145891136	30
31	386178258		1185395877	29
32	390568737		1227736470	28
33	395060088		1273213435	27
34	399655828		1322188681	26
35	404359642		1375082163	25
36	409175388		1432363027	24
37	414111295		1494645462	23
38	419159137		1562590046	22
39	424335793		1637005697	21
40	429641796		1718863124	20
41	435082056		1809337410	19
42	440661780		1909864971	18
43	446386310		2022219818	17
44	452261453		2148619711	16
45	458293185		2291873854	15
46	464487853		2455533838	14
47	470852152		2644433955	13
48	477393195		2864819229	12
49	484118353		3125276745	11
50	491038024		3437829002	10
51	498155754		3819696333	9
52	505482730		4297181900	8
53	513020946		4911098124	7
54	520805157		5729633839	6
55	528821258		6875680006	5
56	537085003		8594003953	4
57	545610968		11457529506	3
58	554414914		17188033688	2
59	563504309		34376070815	1
60	572899830		Infinita.	0
	I		O	

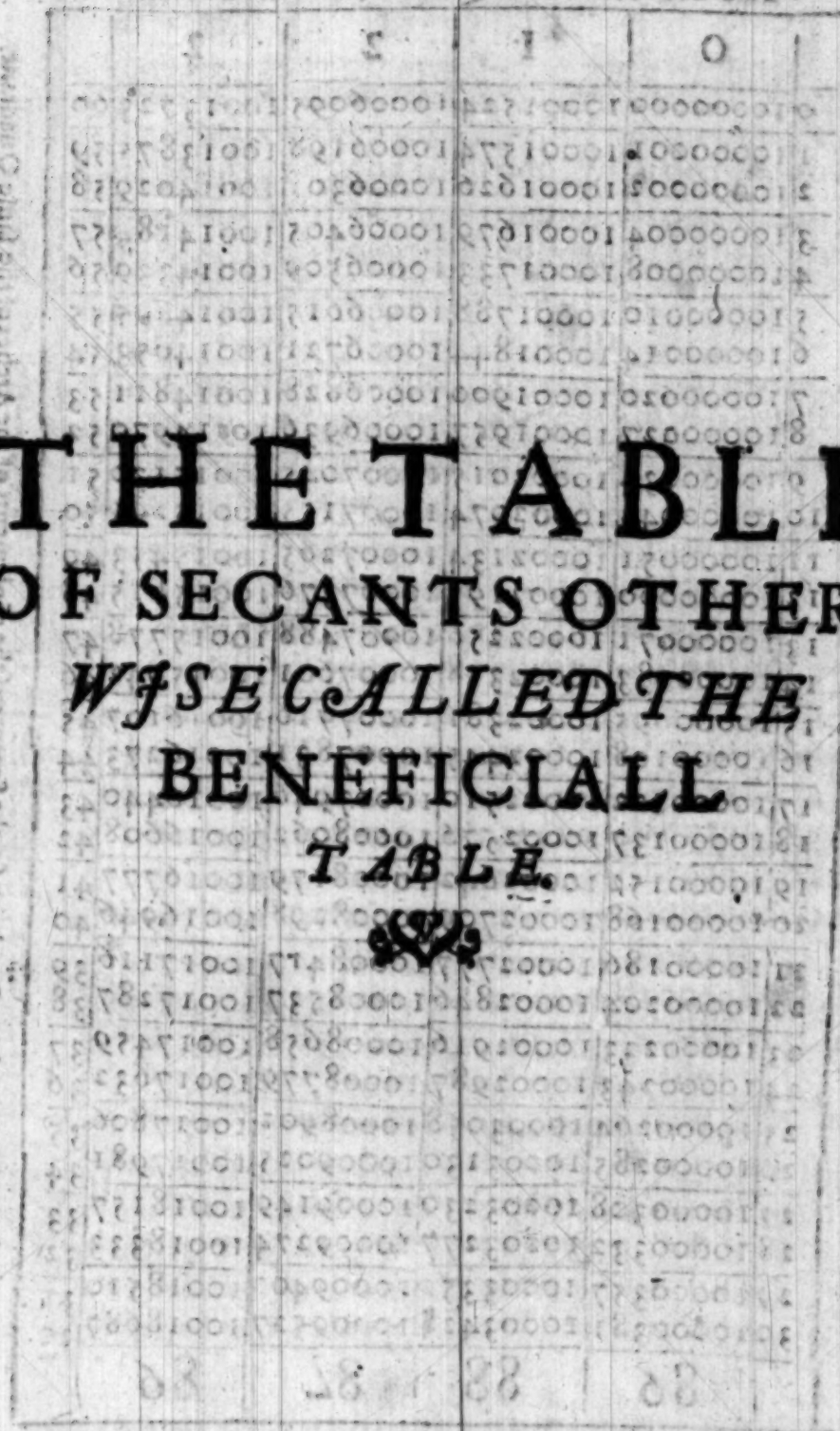
The minutes of the degrees of the Quadrant for the Tangents of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Tangents of the cõplements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Tangents,
of the Arches of the first Quadrant

THE TABLE OF SECANTS OTHER-WISE CALLED THE BENEFICIALL TABLE.



The Table of Secants.

The degrees of the Quadrant for the Secants

	0	1	2	3	
0	10000000	10001524	10006095	10013723	60
1	10000001	10001574	10006198	10013875	59
2	10000002	10001626	10006302	10014029	58
3	10000004	10001679	10006405	10014184	57
4	10000008	10001733	10006509	10014339	56
5	10000010	10001788	10006615	10014495	55
6	10000014	10001844	10006721	10014653	54
7	10000020	10001900	10006828	10014811	53
8	10000027	10001957	10006936	10014970	52
9	10000034	10002015	10007045	10015130	51
10	10000042	10002074	10007155	10015291	50
11	10000051	10002134	10007265	10015453	49
12	10000060	10002195	10007376	10015615	48
13	10000071	10002256	10007488	10015778	47
14	10000083	10002318	10007601	10015942	46
15	10000095	10002381	10007716	10016107	45
16	10000108	10002445	10007831	10016273	44
17	10000122	10002510	10007946	10016440	43
18	10000137	10002576	10008062	10016608	42
19	10000152	10002642	10008179	10016777	41
20	10000168	10002709	10008298	10016946	40
21	10000186	10002777	10008417	10017116	39
22	10000204	10002846	10008537	10017287	38
23	10000223	10002916	10008658	10017459	37
24	10000243	10002987	10008779	10017632	36
25	10000264	10003058	10008902	10017806	35
26	10000285	10003130	10009025	10017981	34
27	10000308	10003230	10009149	10018157	33
28	10000332	10003277	10009274	10018333	32
29	10000357	10003352	10009400	10018510	31
30	10000381	10003428	10009527	10018687	30
	86	88	87	86	

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the complements of the Arches of the same Quadrant.

The Table of Secants.

of the Arches of the same Quadrant.

	0	1	2	3	
30	10000381	10003428	10007527	10018687	30
31	10000407	10003505	10009655	10018865	29
32	10000433	10003582	10009783	10019044	28
33	10000461	10003660	10009912	10019224	27
34	10000489	10003739	10010042	10019405	26
35	10000518	10003819	10010174	10019587	25
36	10000548	10003900	10010306	10019770	24
37	10000579	10003982	10010439	10019954	23
38	10000611	10004060	10010572	10020138	22
39	10000643	10004148	10010706	10020324	21
40	10000677	10004232	10010841	10020510	20
41	10000711	10004317	10010977	10020698	19
42	10000746	10004403	10011114	10020886	18
43	10000782	10004490	10011252	10021086	17
44	10000819	10004578	10011390	10021266	16
45	10000857	10004666	10011529	10021456	15
46	10000895	10004755	10011670	10021649	14
47	10000934	10004845	10011811	10021842	13
48	10000975	10004936	10011952	10022035	12
49	10001016	10005028	10012098	10022239	11
50	10001058	10005122	10012238	10022424	10
51	10001100	10005216	10012383	10022620	9
52	10001144	10005310	10012528	10022817	8
53	10001188	10005405	10012674	10023015	7
54	10001233	10005501	10012822	10023213	6
55	10001280	10005598	10012970	10023412	5
56	10001327	10005696	10013119	10023612	4
57	10001375	10005795	10013269	10023813	3
58	10001423	10005894	10013419	10024014	2
59	10001473	10005994	10013570	10024217	1
60	10001524	10006095	10013723	10024420	0
	89	88	87	86	

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the complements of the Arches of the same Quadrant.

of the complements of the Arches of the same Quadrant.

The Table of Secants.

The degrees of the Quadrant for the Secants

	4	5	6	7	
0	10014420	10038198	10055082	10075098	60
1	10024625	10038454	10055390	10075459	59
2	10024830	10038710	10055699	10075820	58
3	10025036	10038968	10056009	10076182	57
4	10025242	10039226	10056320	10076545	56
5	10025450	10039486	10056632	10076909	55
6	10025658	10039747	10056944	10077274	54
7	10025868	10040008	10057256	10077639	53
8	10026078	10040269	10057570	10078005	52
9	10026289	10040532	10057884	10078372	51
10	10026500	10040796	10058200	10078740	50
11	10026713	10041061	10058517	10079009	49
12	10026927	10041326	10058834	10079479	48
13	10027141	10041592	10059153	10079850	47
14	10027357	10041859	10059472	10080222	46
15	10027573	10042128	10059792	10080595	45
16	10027790	10042397	10060113	10080968	44
17	10028009	10042667	10060435	10081332	43
18	10028227	10042936	10060757	10081717	42
19	10028447	10043207	10061080	10082093	41
20	10028667	10043479	10061405	10082470	40
21	10028889	10043752	10061730	10082848	39
22	10029111	10044025	10062056	10083226	38
23	10029334	10044300	10062383	10083606	37
24	10029559	10044576	10062711	10083987	36
25	10029784	10044853	10063039	10084368	35
26	10030009	10045130	10063369	10084750	34
27	10030236	10045409	10063700	10085134	33
28	10030463	10045689	10064031	10085518	32
29	10030692	10045969	10064364	10085903	31
30	10030920	10046250	10064696	10086289	30
	85	84	83	82	

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrant.

of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrãt.

	4	5	6	7	
30	10030920	10046250	10064696	10086289	30
31	10031150	10046532	10065035	10086677	29
32	10031381	10046815	10065365	10087065	28
33	10031614	10047098	10065701	10087454	27
34	10031846	10047383	10066038	10087843	26
35	10032079	10047669	10066376	10088243	25
36	10032314	10047954	10066715	10088623	24
37	10032550	10048241	10067054	10089015	23
38	10032786	10048529	10067394	10089408	22
39	10033023	10048818	10067735	10089802	21
40	10033261	10049107	10068076	10090196	20
41	10033500	10049398	10068419	10090592	19
42	10033740	10049690	10068763	10090988	18
43	10033981	10049983	10069107	10091385	17
44	10034223	10050276	10069452	10091783	16
45	10034465	10050571	10069808	10092182	15
46	10034708	10050865	10070155	10092582	14
47	10034952	10051160	10070495	10092983	13
48	10035196	10051456	10070842	10093385	12
49	10035441	10051753	10071192	10093787	11
50	10035688	10052051	10071543	10094190	10
51	10035936	10052350	10071895	10094624	9
52	10036184	10052649	10072247	10095030	8
53	10036434	10052951	10072600	10095406	7
54	10036684	10053252	10072954	10095813	6
55	10036934	10053555	10073310	10096221	5
56	10037185	10053858	10073666	10096630	4
57	10037438	10054162	10074023	10097040	3
58	10037690	10054468	10074380	10097451	2
59	10037944	10054775	10074737	10097863	1
60	10038198	10055082	10075098	10098275	0
	85	84	83	82	

of the complements of the Arches of the same Quadrant.

The Table of Secants.

The degrees of the Quadrant for the Secants

	8	9	10	11	
0	10098275	10124650	10154264	10187166	60
1	10098698	10125117	10154786	10187743	59
2	10099103	10125585	10155308	10188320	58
3	10099518	10126054	10155831	10188899	57
4	10099934	10126524	10156356	10189478	56
5	10100351	10126994	10156881	10190058	55
6	10100769	10127465	10157407	10190639	54
7	10101188	10127947	10157934	10191221	53
8	10101607	10128410	10158462	10191804	52
9	10102028	10128684	10158991	10192387	51
10	10102450	10129358	10159520	10192972	50
11	10102872	10129634	10160051	10193557	49
12	10103295	10130311	10160582	10194144	48
13	10103720	10130788	10161114	10194732	47
14	10104144	10131266	10161648	10195320	46
15	10104570	10131746	10162182	10195910	45
16	10104996	10132226	10621707	10196500	44
17	10105423	10132707	10163252	10197092	43
18	10105851	10133189	10163789	10197684	42
19	10106286	10133672	10164327	10198277	41
20	10106710	10134156	10165865	10198872	40
21	10107140	10134641	10165495	10199467	39
22	10107572	10135127	10165944	10200063	38
23	10108005	10135614	10166485	10200060	37
24	10108438	10136102	10167028	10201258	36
25	10108873	10136591	10167571	10201857	35
26	10109309	10137080	10168116	10202457	34
27	10109755	10137571	10168661	10203058	33
28	10110182	10138163	10169207	10203659	32
29	10110620	10138555	10169765	10204262	31
30	10111059	0139048	10170303	10204867	30
	81	80	79	78	

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrant.

of the Arches of the same Quadrant.

	8	9	10	11	
30	10111059	10139048	10170303	10204867	30
31	10111509	10139543	10170852	10205470	29
32	10111940	10140038	10171401	10206075	28
33	10112482	10140534	10171952	10206681	27
34	10112825	10141036	10172504	10207289	26
35	10113279	10141528	10173056	10207897	25
36	10113713	10142027	10173609	10208506	24
37	19214159	10142526	10174163	10209116	23
38	20114606	10143026	10174718	10209727	22
39	10115053	10143528	10175274	10210339	21
40	10115501	10144030	10175831	10210952	20
41	10115951	10244533	10176389	10211566	19
42	10116401	10145037	10176947	10211180	18
43	10116852	10145542	10177507	10212796	17
44	10117303	10146048	10178068	10213412	16
45	10117754	10146554	10178630	10214030	15
46	10118200	10147062	10179193	10214668	14
47	10118663	10147572	10179756	10215268	13
48	10119118	10148082	10180321	10215889	12
49	10119574	10148593	10180886	10216510	11
50	10120031	10149104	10181453	10217113	10
51	10120489	10149615	10182021	10217756	9
52	10120948	10150128	10182589	10218380	8
53	10121408	10150642	10183158	10219015	7
54	10121868	10151156	10183728	10219631	6
55	10122330	10151672	10484299	10220258	5
56	10122792	10152188	10184870	10220885	4
57	10123256	10152705	10185443	10221514	3
58	10123720	10153224	10186017	10222143	2
59	10124275	10153744	10186591	10222774	1
60	10124650	10154264	10187166	10223405	0
	81	80	79	78	

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrat.

of the complements of the Arches of the same Quadrant.

The Table of Secants.

The degrees of the Quadrant for the Secants

	12	13	14	15	
0	10223405	10263040	10306134	10352762	60
1	10224037	10263730	10306884	10353569	59
2	10224671	10264422	10307633	10354377	58
3	10225305	10265112	10308383	10355186	57
4	10225941	10265804	10309134	10355996	56
5	10226577	10266498	10309886	10356807	55
6	10227215	10267192	10310639	10357619	54
7	10227854	10267888	10311393	10358433	53
8	10228493	10268584	10312148	10359247	52
9	10229134	10269281	10312903	10360063	51
10	10229775	10269979	10313660	10360880	50
11	10230417	10270688	10314417	10361698	49
12	10231060	10271379	10315176	10362517	48
13	10231644	10272080	10315935	10363337	47
14	10232288	10272782	10316696	10364158	46
15	10232994	10273485	10317457	10364980	45
16	10233641	10274190	10318220	10365802	44
17	10234289	10274895	10318984	10366626	43
18	10234938	10275601	10319749	10367450	42
19	10235587	10276318	10320525	10368276	41
20	10236238	10277016	10321282	10369102	40
21	10236889	10277726	10322050	10369930	39
22	10237541	10278436	10322819	10370758	38
23	10238195	10279148	10323589	10371588	37
24	10238849	10279860	10324359	10372418	36
25	10239505	10280573	10325131	10373250	35
26	10240161	10281287	10325903	10374092	34
27	10240818	10282002	10326677	10374916	33
28	10241476	10282717	10327451	10375750	32
29	10242135	10283434	10328127	10376586	31
30	10242795	10284151	10329003	10377422	30
	77	76	75	74	

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrant.

of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

	12	13	14	15	
30	10241795	10284151	10329003	10377422	30
31	10243456	10284870	10329781	10378260	29
32	10244118	10285589	10330559	10379098	28
33	10245782	10286310	10331339	10379938	27
34	10245445	10287032	10332119	10380778	26
35	10246110	10287754	10332902	10381620	25
36	10246776	10288478	10333684	10382463	24
37	10247442	10289202	10334467	10383307	23
38	10248110	10289928	10335252	10384153	22
39	10248778	10290654	10336037	10384999	21
40	10249448	10291381	10336824	10385846	20
41	10250119	10292119	10337612	10386694	19
42	10250790	10292838	10338400	10387543	18
43	10251461	10293569	10339189	10388393	17
44	10252136	10294300	10339980	10389244	16
45	10252811	10295043	10340771	10390096	15
46	10253482	10295766	10341564	10390949	14
47	10254162	10296501	10342347	10391803	13
48	10254832	10297237	10343152	10392657	12
49	10255517	10297973	10343947	10393513	11
50	10256196	10298710	10344743	10394370	10
51	10256876	10299449	10345541	10395228	9
52	10257557	10300188	10346340	10396087	8
53	10258239	10300928	10347139	10396947	7
54	10258922	10301669	10347940	10397808	6
55	10259606	10302411	10348741	10398670	5
56	10260291	10303154	10349544	10399533	4
57	10260977	10303898	10350347	10400397	3
58	10261661	10304643	10351151	10401262	2
59	10262351	10305390	10351956	10402128	1
60	10263040	10306136	10352762	10402994	0
	77	76	75.	74	

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrãt.

of the complements of the Arches of the same Quadrant.

The Table of Secants.

The degrees of the Quadrant for the Secants

	16	17	18	19	
0	10402994	10456917	10514621	10576207	60
1	10403862	10457847	10515616	10577267	59
2	10404730	10458779	10516612	10578328	58
3	10405590	10459711	10517609	10579400	57
4	10406471	10460645	10518607	10580463	56
5	10407343	10461580	10519606	10581518	55
6	10408216	10462516	10520606	10582583	54
7	10409091	10463453	10521607	10583650	53
8	10409966	10464391	10522608	10584717	52
9	10410843	10465330	10523611	10585795	51
10	10411721	10466270	10524615	10586855	50
11	10412600	10467211	10525620	10587925	49
12	10413479	10468153	10526626	10588997	48
13	10414360	10469096	10527633	10590070	47
14	10415241	10470041	10528642	10591145	46
15	10416124	10479986	10529651	10592220	45
16	10417007	10471933	10530662	10593297	44
17	10417892	10472880	10531673	10594375	43
18	10418778	10473829	10532686	10595455	42
19	10419665	10474778	10533699	10596534	41
20	10420553	10475729	10534714	10597615	40
21	10421442	10476680	10535730	10598697	39
22	10402333	10477633	10536747	10599780	38
23	10423224	10478587	10537765	10600865	37
24	10424116	10479542	10538785	10601950	36
25	10425009	10480498	10539805	10603037	35
26	10425903	10481454	10540826	10604125	34
27	10426798	10482412	10541848	10605214	33
28	10427694	10483371	10542872	10606304	32
29	10428591	10484331	10543897	10607395	31
30	10429489	10485292	10544923	10608487	30
	73	72	71	70	

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrant.

of the Arches of the same Quadrant.

	16	17	18	19	
30	10429489	10485292	10544923	10608487	30
31	10430388	10486254	10545950	10609580	29
32	10431288	10487217	10546977	10610675	28
33	10432189	10488181	10548006	10611770	27
34	10433091	10489146	10549036	10612867	26
35	10433995	10490113	10550067	10613964	25
36	10434899	10491080	10551099	10615063	24
37	10435805	10492049	10552133	10616163	23
38	10436711	10493018	10553168	10617264	22
39	10437619	10493989	10554204	10618366	21
40	10438528	10494961	10555241	10619469	20
41	10439436	10494934	10556279	10620574	19
42	10440346	10496908	10557318	10621680	18
43	10441257	10497883	10558359	10622787	17
44	10442170	10498059	10559400	10623895	16
45	10443083	10499836	10560443	10625004	15
46	10443998	10500814	10561496	10626114	14
47	10444913	10501793	10562531	10627226	13
48	10445830	10502773	10563577	10628338	12
49	10446749	10503754	10564623	10629451	11
50	10447668	10504736	10565670	10630566	10
51	10448588	10505719	10566719	10631682	9
52	10449509	10506704	10567769	10632799	8
53	10450431	10507689	10568820	10633917	7
54	10451354	10508676	10569872	10635037	6
55	10452279	10509664	10570925	10636157	5
56	10453204	10510653	10571980	10637279	4
57	10454131	10511643	10573034	10638402	3
58	10455058	10512635	10574091	10639526	2
59	10455987	10513627	10575149	10640651	1
60	10456917	10514621	10576207	10641777	0
	73	72	71	70	

of the complements of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrant

The Table of Secants.

The degrees of the Quadrant for the Secants.

	20	21	22	23	
0	10641777	10711449	10785347	10863603	60
1	10642905	10712646	10786616	10864945	59
2	10644034	10713888	10787885	10866289	58
3	10645164	10715042	10789155	10867633	57
4	10646295	10716242	10760427	10868979	56
5	10647427	10717444	10791700	10870326	55
6	10648560	10718647	10792974	10871675	54
7	10649694	10719850	10794250	10873024	53
8	10650829	10721056	10795527	10874374	52
9	10651965	10722261	10796805	10875626	51
10	10653103	10723469	10798085	10877079	50
11	10654242	10724677	10799365	10878434	49
12	10655381	10725887	10800647	10879790	48
13	10656522	10727098	10803214	10881147	47
14	10657664	10728310	10803214	10882506	46
15	10658807	10729524	10804500	10883865	45
16	10659951	10730738	10805787	10885226	44
17	10661097	10731953	10807074	10886588	43
18	10662244	10733170	10808363	10887952	42
19	10663392	10734387	10809652	10889317	41
20	10664541	10735606	10810942	10890683	40
21	10665692	10736826	10812234	10892051	39
22	10666844	10738048	10813528	10893417	38
23	10667996	10739270	10814823	10894788	37
24	10669150	10740494	10816119	10896159	36
25	10670304	10741719	10817417	10897531	35
26	10671460	10742945	10818715	10898905	34
27	10672617	10744173	10820015	10900280	33
28	10673776	10745401	10821316	10901656	32
29	10674936	10746631	10822617	10903033	31
30	10676096	10747864	10823920	10904413	30
	69	68	67	66	

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secans of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrãt.

of th e Arches of the ſame Quadrant.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the ſame Quadrant.

	20	21	22	23	
30	10676096	10747864	10823920	10904413	30
31	10677258	10749094	10825225	10905790	29
32	10678420	10750327	10826531	10907171	28
33	10679584	10751561	10827838	10908553	27
34	10680749	10752797	10829146	10909936	26
35	10681915	10754034	10830455	10911322	25
36	10683082	10755273	10831766	10912709	24
37	10684250	10756513	10833078	10914096	23
38	10685420	10757753	10834391	10915484	22
39	10686519	10758995	10835706	10916874	21
40	10687763	10760237	10837023	10918265	20
41	10688936	10761481	10838341	10919657	19
42	10690111	10762726	10839660	1092 1051	18
43	10691287	10763972	10840980	10922436	17
44	10692464	10765220	10842301	10923833	16
45	10693642	10766469	10843623	10925241	15
46	10694821	10767720	10844947	10926641	14
47	10696001	10768971	10846272	10928041	13
48	10697182	10770224	10847597	10929442	12
49	10698364	10771477	10848924	10930846	11
50	10699548	10772732	10850252	10932249	10
51	10700732	10773988	10851583	10933654	9
52	10701918	10775244	10852914	10935061	8
53	10703 105	10776502	10854246	10936469	7
54	10704294	10777761	10855578	10937879	6
55	10705483	10779022	10856912	10939290	5
56	10706674	10780284	10858247	10940702	4
57	10707866	10781547	10859584	10942115	3
58	10709059	10782802	10860922	10943527	2
59	10710254	10784078	10862262	10944945	1
60	10711449	10785347	10863603	10946362	0
	69	68	67	66	

The minutes of degrees of the Quadrant for the Secants of the complements of the Arches of the ſame Quadrant

of the complements of the Arches of the ſame Quadrant

The Table of Secants.

The degrees of the Quadrant for the Secants.

	24	25	26	27	
0	10946362	11033783	11126021	11223262	60
1	10947781	11035280	11127601	11224927	59
2	10949201	11036779	11129182	11226593	58
3	10950622	11038279	11130765	11228260	57
4	10952045	11039780	11132349	11229929	56
5	10953469	11041283	11133933	11231599	55
6	10954898	11042787	11135519	11233270	54
7	10956320	11044293	11137106	11234943	53
8	10957747	11045799	11138694	11236617	52
9	10959175	11047306	11140284	11238292	51
10	10960605	11048815	11141875	11239969	50
11	10962036	11050325	11143467	11241648	49
12	10963469	11051837	11145061	11243329	48
13	10964903	11053350	11146656	11245011	47
14	10966338	11054865	11148254	11246694	46
15	10967775	11056381	11149853	11248378	45
16	10969213	11057898	11151453	11250064	44
17	10970652	11059420	11153055	11251751	43
18	10972092	11060939	11154658	11253440	42
19	10973533	11062461	11156262	11255130	41
20	10974976	11063985	11157868	11256822	40
21	10976420	11065510	11159475	11258516	39
22	10977865	11067037	11161084	11260211	38
23	10979312	11068564	11162694	11261907	37
24	10980760	11070092	11164306	11263605	36
25	10982210	11071621	11165919	11265304	35
26	10983661	11073152	11167533	11267005	34
27	10985113	11074684	11169149	11268707	33
28	10986567	11076218	11170766	11270410	32
29	10988022	11077753	11172385	11272114	31
30	10989480	11079289	11174006	11273820	30
	65	64	63	62	

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrat.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrat.

of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

	24	25	26	27	
30	10989480	11079289	11174006	11273820	30
31	10990938	11080827	11175627	11275528	29
32	10992398	11082366	11177249	11277238	28
33	10993859	11083906	11178873	11278949	27
34	10995321	11085448	11180499	11280661	26
35	10996783	11086990	11182125	11282374	25
36	10998247	11088536	11183753	11284089	24
37	10999712	11090082	11185383	11285805	23
38	11001179	11091629	11187014	11287524	22
39	11002647	11093178	11188647	11289244	21
40	11004116	11094729	11190281	11290965	20
41	11005587	11096280	11191916	11292688	19
42	11007059	11097833	11193553	11294412	18
43	11008533	11099387	11195191	11296132	17
44	11010008	11100943	11196831	11297864	16
45	11011484	11102500	11198472	11299593	15
46	11019262	11104058	11200114	11301324	14
47	11014441	11105617	11201758	11303056	13
48	11015921	11107179	11203404	11304789	12
49	11017402	11108741	11205051	11306523	11
50	11018884	11110306	11206700	11308259	10
51	11010367	11111871	11208550	11309996	9
52	11021852	11113438	11210001	11311735	8
53	11023338	11115006	11211654	11313476	7
54	11024826	11116575	11213308	11315218	6
55	11026315	11118145	11214963	11316961	5
56	11027806	11119717	11216620	11318706	4
57	11029298	11121290	11218278	11319452	3
58	11030791	11122865	11219938	11322199	2
59	11032287	11124442	11221599	11323949	1
60	11033783	11126021	11223262	11325700	0
	65	64	63	62	

The minutes of degrees of the Quadrant for the Secants of the complements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant.

The Table of Secants.

The degrees of the Quadrant for the Secants.

	28	29	30	31	
0	11325700	11433540	11547004	11666331	60
1	11327452	11435384	11548944	11668371	59
2	11329206	11437230	11550886	11670413	58
3	11330961	11439078	11552829	11672457	57
4	11332718	11440927	11554774	11674502	56
5	11334479	11442777	11556720	11676548	55
6	11336237	11444629	11558669	11678597	54
7	11337999	11446483	11560619	11680647	53
8	11339762	11448339	11562570	11682698	52
9	11341526	11450196	11564523	11684752	51
10	11343292	11452054	11566480	11686807	50
11	11345060	11453915	11568434	11688864	49
12	11346830	11455776	11570393	11690923	48
13	11348601	11457639	11572353	11692984	47
14	11350373	11459503	11574314	11695046	46
15	11352149	11461370	11576277	11697110	45
16	11353923	11463238	11578242	11699176	44
17	11355698	11465107	11580208	11701243	43
18	11357475	11466978	11582175	11703312	42
19	11359255	11468850	11584145	11705383	41
20	11361036	11470723	11586116	11707455	40
21	11362819	11472599	11588089	11709530	39
22	11364603	11474483	11590064	11711606	38
23	11366389	11476354	11592040	11713684	37
24	11368177	11478235	11594018	11715764	36
25	11369966	11480117	11595998	11717845	35
26	11371756	11482001	11597979	11719928	34
27	11373548	11483887	11599961	11722012	33
28	11375341	11485774	11601946	11724099	32
29	11377136	11487662	11603932	11726187	31
30	11378933	11489353	11605919	11728276	30
	61	60	59	58	

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrãt.

of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant

	28	29	30	31	
30	11378933	11489353	11605919	11728276	30
31	11380731	11491445	11607909	11730367	29
32	11382530	11493338	11609900	11732460	28
33	11384331	11495233	11611893	11734555	27
34	11386134	11497140	11613888	11736652	26
35	11387938	11499028	11615876	11738751	25
36	11389744	11500928	11617882	11740851	24
37	11391551	11502829	11619881	11742953	23
38	11393359	11504731	11621882	11745057	22
39	11395169	11506626	11623885	11747162	21
40	11396981	11508532	11625889	11749269	20
41	11398794	11510450	11627996	11751378	19
42	11400609	11512360	11629904	11753489	18
43	11402425	11514271	11631913	11755603	17
44	11404243	11516183	11633924	11757718	16
45	11406063	11518097	11635937	11759834	15
46	11407884	11520013	11637952	11761951	14
47	11409706	11521930	11639968	11764069	13
48	11411530	11523849	11641986	11766190	12
49	11413356	11525770	11644005	11768312	11
50	11415183	11527692	11646026	11770437	10
51	11417012	11529616	11648049	11772564	9
52	11418842	11531542	11650075	11774696	8
53	11420673	11533469	11652099	11776822	7
54	11422507	11535398	11654127	11778954	6
55	11424342	11537328	11656156	11781088	5
56	11426178	11539260	11658188	11783223	4
57	11428916	11541193	11660221	11785361	3
58	11429856	11543128	11662256	11787500	2
59	11431689	11545065	11664292	11789640	1
60	11433540	11547004	11666331	11791783	0
	61	60	59	58	

The minutes of degrees of the Quadrant for the Secants of the complements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Secants.

The degrees of the Quadrant for the Secants.

	32	33	34	35	
0	11791783	11923633	12062179	12207745	60
1	11793927	11925886	12064546	12210233	59
2	11796073	11928141	12066916	12212723	58
3	11798221	11930397	12069286	12215214	57
4	11800371	11932656	12071660	12217708	56
5	11802522	11934917	12074036	12220204	55
6	11804675	11937180	12076413	12222702	54
7	11806830	11939445	12078792	12225201	53
8	11808987	11941701	12081174	12227703	52
9	11811145	11943979	12083558	12230207	51
10	11813306	11946250	12085943	12232713	50
11	11815468	11948522	12088330	12235221	49
12	11817632	11950796	12090720	12237732	48
13	11819797	11953071	12093111	12240245	47
14	11821965	11955349	12095504	12242759	46
15	11824134	11957629	12097899	12245275	45
16	11826306	11959610	12100296	12247794	44
17	11828479	11962194	12102696	12250315	43
18	11830654	11964479	12105097	12252837	42
19	11832830	11966766	12107500	12255361	41
20	11835008	11969055	12109905	12257888	40
21	11837188	11971346	12112312	12260417	39
22	11839369	11973638	12114722	12262948	38
23	11841552	11975932	12117133	12265481	37
24	11843737	11978229	12119546	12268016	36
25	11845924	11980527	12121960	12270553	35
26	11848114	11982828	12124377	12273093	34
27	11850305	11985131	12126796	12275634	33
28	11852498	11987435	12119216	12278187	32
29	11854693	11989741	12131638	12280722	31
30	11856890	11992050	12134063	12283270	30
	57	56	55	54	

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the complements of the Arches of the same Quadrat.

of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

	32	33	34	35	
30	11850890	11992050	12134063	12283270	30
31	11859088	11994360	12136490	12285820	29
32	11861288	11996672	12138919	12288372	28
33	11863489	11998986	12141350	12290925	27
34	11865693	12001303	12143783	12293481	26
35	11867899	12003619	12146218	12296039	25
36	11870107	12005938	12148656	12298599	24
37	11872316	12008259	12150095	12301161	23
38	11874527	12010582	12153536	12303725	22
39	11876739	12012907	12155978	12306291	21
40	11878954	12015233	12158423	12308859	20
41	11881171	12017562	12160870	12311430	19
42	11883389	12019893	12163319	12314003	18
43	11885609	12022226	12165770	12316578	17
44	11887831	12024560	12168223	12319156	16
45	11890054	12026897	12170677	12321736	15
46	11892280	12029236	12173135	12324317	14
47	11894508	12031576	12175594	12326900	13
48	11896737	12033919	12178055	12329486	12
49	11898968	12036264	12180518	12332074	11
50	11901202	12038610	12182983	12334664	10
51	11903437	12040958	12185450	12337256	9
52	11905674	12043309	12187919	12339851	8
53	11907912	12045661	12190390	12342448	7
54	11910153	12048016	12192864	12345046	6
55	11912395	12050372	12195340	12347646	5
56	11914640	12052730	12197817	12350249	4
57	11916886	12055089	12200296	12352854	3
58	11919133	12057451	12202777	12355460	2
59	11921382	12059814	12205260	12358068	1
60	11923633	12063179	12207745	12360678	0
	57	56	55	54	

The minutes of degrees of the Quadrant for the Secants of the complements of the Arches of the same Quadrat.

of the complements of the Arches of the same Quadrant.

The Table of Secants.

The degrees of the Quadrant for the Secants.

	36	37	38	39	
0	12360678	12521357	12690184	12867599	60
1	12363290	12524103	12693070	12870632	59
2	12365906	12526851	12695957	12873667	58
3	12368524	12529601	12698847	12876704	57
4	12371144	12532354	12701739	12879744	56
5	12373766	12535110	12704634	12882787	55
6	12376391	12537867	12707531	12885832	54
7	12379018	12540627	12710430	12888879	53
8	12381647	12543389	12713332	12891929	52
9	12384278	12546152	12716236	12894982	51
10	12386911	12548918	12719143	12898035	50
11	12389546	12551686	12722052	12901094	49
12	12392183	12554456	12724964	12904155	48
13	12394822	12557229	12727878	12907218	47
14	12397464	12560005	12730794	12910283	46
15	12400108	12562783	12733713	12913351	45
16	12402754	12565563	12736635	12916422	44
17	12405402	12568345	12739559	12919494	43
18	12408053	12571130	12742485	12922569	42
19	12410705	12573917	12745413	12925647	41
20	12413359	12576706	12748344	12928727	40
21	12416015	12579597	12751277	12931809	39
22	12418674	12582912	12754213	12934895	38
23	12421335	12585087	12757151	12937983	37
24	12433998	12587885	12760092	12941073	36
25	12426663	12590685	12763035	12944166	35
26	12429331	12593488	12765981	12947262	34
27	12432001	12596293	12768929	12950360	33
28	12434673	12599101	12771880	12953461	32
29	12437348	12601911	12774833	12956565	31
30	12440024	12604724	12777788	12959671	30
	53	52	51	50	

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants the of Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the coplements of the Arches of the same Quadrat.

of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant, for the Secants of the Arches of the same Quadrant.

	36	37	38	39	
30	12440024	12604724	12777788	12959671	30
31	12442702	12607539	12780746	12962780	29
32	12445383	12610356	12783707	12965892	28
33	12448066	12613175	12786670	12969007	27
34	12450751	12615997	12789635	12972124	26
35	12453438	12618821	12792602	12975243	25
36	12456128	12621648	12795573	12978366	24
37	12458821	12624477	12798546	12981491	23
38	12461516	12627308	12801521	12984618	22
39	12464213	12630141	12804498	12987747	21
40	12466913	12632977	12807478	12990880	20
41	12469614	12635815	12810460	12994015	19
42	12472317	12638655	12813445	12997153	18
43	12475022	12641597	12816432	13000293	17
44	12477730	12644343	12819422	13003436	16
45	12480440	12646191	12822415	13006582	15
46	12483152	12650041	12825410	13009730	14
47	12485866	12652893	12828407	13012881	13
48	12488583	12655748	12831407	13016034	12
49	12491302	12658605	12834409	13019189	11
50	12494022	12661464	12837414	13022348	10
51	12496743	12664325	12840421	13025509	9
52	12499469	12667189	12843431	13028673	8
53	12502197	12670050	12846443	13031839	7
54	12504927	12672924	12849458	13035008	6
55	12507659	12675795	12852475	13038180	5
56	12510394	12678668	12855495	13041354	4
57	12513132	12681543	12858517	13044530	3
58	12515871	12684421	12861542	13047710	2
59	12518613	12687301	12864569	13050892	1
60	12521357	12690184	12867699	13054077	0
	53	55	51	50	

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrãt.

of the complements of the Arches of the same Quadrant.

The Table of Secants.

The degrees of the Quadrant for the Secants

	40	41	42	43	
0	13054077	13250131	13456320	13673275	60
1	13057264	13253482	13459851	13676986	59
2	13060455	13256835	13463380	13680700	58
3	13063646	13260192	13466912	13684417	57
4	13066843	13263582	13470447	13688138	56
5	13070042	13266915	13473985	13691861	55
6	13073242	13270282	13477527	13695587	54
7	13076445	13273651	13481071	13699316	53
8	13079651	13277023	13484618	13703048	52
9	13082859	13280397	13488168	13706783	51
10	13086071	13283775	13491721	13710523	50
11	13089285	13287155	13495276	13714266	49
12	13092502	13290538	13498835	13718012	48
13	13095721	13293924	17502397	13721761	47
14	13098944	13297313	13505962	13725514	46
15	13102169	13300704	13509530	13729270	45
16	13105397	13304098	13513101	13733029	44
17	13108627	13307495	13516675	13736790	43
18	13111861	13310896	13520252	13740555	42
19	13114098	13314299	13523832	13744322	41
20	13118337	13317705	13527416	13748092	40
21	13121578	13321114	13531003	13751867	39
22	13124823	13324526	13534593	13755644	38
23	13128070	13327941	13538185	13759424	37
24	13131320	13331359	13541781	13763209	36
25	13134572	13334779	13545380	13766997	35
26	13134828	13338203	13548981	13770788	34
27	13141085	13341629	13552585	13774582	33
28	13144346	13345058	13556193	13778380	32
29	13147509	13348490	13559803	13782181	31
30	13150874	13351924	13563417	13785985	30
	49	48	47	46	

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the coplements of the Arches of the same Quadrant.

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of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

	40	41	42	43	
30	13150874	13351924	13563417	13785985	30
31	13154142	13355361	13567034	13789792	29
32	13157413	13358802	13570654	13793603	28
33	13160687	13362245	13574277	13797416	27
34	13163964	13365691	13577903	13801233	26
35	13167243	13369140	13581532	13805053	25
36	13170526	13372592	13585164	13808876	24
37	13173811	13376057	13588799	13812703	23
38	13177099	13379505	13592438	13816534	22
39	13180389	13382966	13596079	13820368	21
40	13183682	13386430	13599723	13824205	20
41	13186978	13389897	13603370	13828045	19
42	13190276	13393367	13607021	13831889	18
43	13193577	13396839	13610975	13835736	17
44	13196882	13400315	13614331	13839586	16
45	13200189	13403794	13617992	13843439	15
46	13203499	13407275	13621656	13847296	14
47	13206812	13410759	13625323	13851156	13
48	13210128	13414247	13628993	13855019	12
49	13213447	13417738	13632666	13858885	11
50	13216769	13421232	13636342	13862755	10
51	13220093	13424728	13640021	13866628	9
52	13223421	13428227	13643704	13870505	8
53	13226750	13431729	13647390	13874385	7
54	13230082	13435234	13651078	13878268	6
55	13233417	13438742	13654769	13882154	5
56	13236754	13442253	13658464	13886044	4
57	13240094	13445767	13662162	13889636	3
58	13243437	13449284	13665863	13893833	2
59	13246783	13452804	13669567	13897733	1
60	13250131	13456326	13673275	13901636	0
	49	48	47	46	

The minutes of degrees of the Quadrant for the Secants of the complements of the Arches of the same Quadrat.

of the complements of the Arches of the same Quadrant.

The Table of Secants.

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

	44	45	46	47	
0	13901636	14142135	14395564	14662790	60
1	13905542	14146251	14399901	14667366	59
2	13909451	14150371	14404242	14671946	58
3	13913365	14154494	14408587	14676530	57
4	13917281	14158621	14412937	14681119	56
5	13921201	14162751	4417290	14685712	55
6	13925126	14166884	14421647	14690309	54
7	13929052	14171021	14426008	14694910	53
8	13932982	14175162	14430374	14699514	52
9	13936916	14179306	14434743	14704122	51
10	13940854	14183454	14439116	14708735	50
11	13944795	14187606	14443493	14713352	49
12	13948739	14191761	14447874	14717973	48
13	13952686	14195919	14452259	14722598	47
14	13956638	14200082	14456648	14727228	46
15	13960592	14204248	14461040	14731862	45
16	13964550	14208418	14465437	14736500	44
17	13968511	14212591	14469838	14741142	43
18	13972476	14216769	14474242	14745788	42
19	13976444	14220950	14478650	14750438	41
20	13980416	14225135	14483062	14755094	40
21	13984391	14229324	14487478	14759753	39
22	13988370	14233517	14491898	14764416	38
23	13992352	14237713	14496322	14769083	37
24	13996338	14241912	14500750	14773755	36
25	14000327	14246115	14505182	14778430	35
26	14004319	14250321	14509617	14783110	34
27	14008315	14254531	14514056	14787794	33
28	14012314	14258745	14518500	14792482	32
29	14016316	14262961	14522946	14797174	31
30	14020322	14267182	14527397	14801871	30
	45	44	43	42	

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrant.

The degrees of the Quadrant for the Secants

of the Arches of the same Quadrant.

	44	45	46	47	
30	14020322	14267182	14527397	14801871	30
31	14024332	14271407	14531852	14806571	29
32	14028345	14275635	14536311	14811276	28
33	14032361	14279867	14540773	14815985	27
34	14036381	14284103	14545250	14820698	26
35	14040404	14288343	14549711	14825416	25
36	14044431	14292587	14554186	14830139	24
37	14048461	14296834	14558665	14834866	23
38	14052494	14301086	14563148	14839597	22
39	14056531	14305331	14567635	14844332	21
40	14060572	14309599	14572126	14849072	20
41	14064616	14313861	14576621	14853815	19
42	14068664	14318127	14581120	14858563	18
43	14072715	14322396	14585624	14863315	17
44	14076770	14326670	14590131	14868071	16
45	14080829	14330947	14594642	14872831	15
46	14084891	14335228	14599157	14877597	14
47	14088956	14339513	14603676	14882377	13
48	14093026	14343802	14608199	14887141	12
49	14097099	14348095	14612725	14891919	11
50	14101175	14352391	14617256	14896701	10
51	14105255	14356691	14621791	14901487	9
52	14109339	14360995	14626330	14906278	8
53	14113427	14365303	14630873	14911073	7
54	14117518	14369615	14635421	14915873	6
55	14121612	14373930	14639973	14920677	5
56	14125709	14378350	14644528	14925486	4
57	14129810	14382573	14649087	14930299	3
58	14133915	14386900	14653651	14935116	2
59	14138023	14391230	14658218	14939938	1
60	14142135	14395564	14662790	14944764	0
	45	44	43	42	

of the complements of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cōplements of the Arches of the same Quadrāt.

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The degrees of the Quadrant for the Secants.

	48	49	50	51	
0	14944764	15242532	15557239	15890158	60
1	14949594	15247634	15562635	15895867	59
2	14954429	15252741	15568036	15901586	58
3	14959268	15257852	15573441	15907307	57
4	14964112	15262969	15578852	15913034	56
5	14968960	15268090	15584267	15918766	55
6	14973812	15273216	15589688	15924504	54
7	14978668	15278347	15595114	15930247	53
8	14983530	15283484	15600545	15936095	52
9	14988396	15288626	15605981	15941748	51
10	14993266	25293773	15611422	15947508	50
11	14998104	15298924	15616868	15953273	49
12	15003020	15304080	15622319	15959044	48
13	15007903	15309240	15627775	15964820	47
14	15012791	15314405	15633237	15970603	46
15	15017683	15319574	15639704	15976390	45
16	15022580	15324748	15644177	15982184	44
17	15027481	15329926	15649655	15987983	43
18	15032387	15335109	15655138	15993788	42
19	15037297	15340297	15660626	15999599	41
20	15042212	15345491	15666119	16005416	40
21	15047131	15350689	15671617	16011237	39
22	15052054	15355892	15677121	16017065	38
23	15056982	15361100	15682630	16022898	37
24	15061915	15366313	15688144	16028736	36
25	15066852	15371530	15693663	16034579	35
26	15071791	15376753	15699188	16040429	34
27	15076739	15381980	15704717	16046283	33
28	15081690	15387212	15710252	16052143	32
29	15086645	15392449	15715791	16058008	31
30	15091605	15397692	15721337	16063878	30
	14	40	39	38	

The degrees of the Quadrant for the Secants.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrãt.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

	48	49	50	51	
30	15091605	15397692	15721337	16063878	30
31	15096569	15402939	15726887	16069754	29
32	15101538	15408191	15732443	16075637	28
33	15106571	15413447	15738003	16081524	27
34	15111490	15418708	15743569	16087418	26
35	15116472	15423974	15749141	16093318	25
36	15121459	15429246	15754718	16099224	24
37	15126451	15434522	15760300	16105135	23
38	15131447	15439803	15765889	16111053	22
39	15136447	15445089	15771479	16116976	21
40	15141453	15450380	15777077	16122905	20
41	15146463	15455675	15782680	16128839	19
42	15151478	15460976	15788289	16134779	18
43	15156497	15466182	15793903	16140724	17
44	15161520	15471593	15799523	16146676	16
45	15166548	15476908	15805147	16152634	15
46	15171581	15482229	15810777	16158598	14
47	15176619	15487554	15816412	16164567	13
48	15181661	15492885	15822052	16170542	12
49	15186708	15498220	15827697	16176522	11
50	15191760	15503560	15833349	16182509	10
51	15196816	15508905	15839005	16188501	9
52	15201877	15514256	15844667	16194499	8
53	15206943	15519611	15850335	16200503	7
54	15212013	15524972	15856008	16206513	6
55	15217088	15530338	15861676	16212528	5
56	15222168	15535710	15867370	16218550	4
57	15227253	15541083	15873058	16224577	3
58	15232342	15546463	15878753	16239610	2
59	15237435	15551848	15884453	16236648	1
60	15242532	15557239	15890158	16242692	0
	41	40	39	38	

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Secants.

The degrees of the Quadrant for the Secants.

	52	53	54	55	
0	16242692	16616402	17013017	17434469	60
1	16248742	16622819	17019832	17441715	59
2	16254799	16629243	17026654	17448968	58
3	16260861	16635673	17033482	17456229	57
4	16266929	16642109	17040318	17463499	56
5	16273003	16648551	17047160	17470775	55
6	16279083	16655001	17054010	17478059	54
7	16285169	16661457	17060866	17485351	53
8	16291261	16667919	17067729	17492650	52
9	16297358	16674408	17074599	17499957	51
10	16303461	16680864	17081476	17507272	50
11	16309570	16687345	17088359	17514594	49
12	16315685	16693835	17095250	17521924	48
13	16321806	16700328	17102148	17529262	47
14	16327934	16706829	17109053	17536607	46
15	16334067	16713336	17115965	17543959	45
16	16340197	16719850	17122885	17551319	44
17	16346353	16726362	17129812	17558687	43
18	16352505	16732877	17136747	17566063	42
19	16358663	16739430	17143689	17573446	41
20	16364827	16745970	17150638	17580837	40
21	16370996	16752517	17157593	17588236	39
22	16377172	16759070	17164556	17595643	38
23	16383359	16765629	17171525	17603057	37
24	16389542	16772195	17178502	17610480	36
25	16395736	16778767	17185495	17617909	35
26	16401936	16785347	17192476	17625347	34
27	16408152	16791933	17199472	17632793	33
28	16414365	16798525	17206477	17640246	32
29	16420573	16805124	17213488	17647707	31
30	16426798	16811729	17220507	17655174	30
	37	36	35	34	

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants the of Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrãt.

of the Arches of the same Quadrant.

	52	53	54	55	
30	16426798	16811729	17220507	17655175	30
31	16433027	16818341	17227532	17662651	29
32	16439263	16824960	17234565	17670136	28
33	16445505	16831585	17241605	17677627	27
34	16451754	16838217	17248653	17685127	26
35	16458008	16844856	17255708	17692635	25
36	16464269	16851502	17262770	17700151	24
37	16470536	16858154	17269839	17707674	23
38	16476809	16864813	17276917	17715206	22
39	16483089	16871479	17284002	17722744	21
40	16489385	16878151	17291095	17730290	20
41	16495668	16884830	17298194	17737844	19
42	16501967	16891515	17305300	17745407	18
43	16508272	16898207	17312413	17752978	17
44	16514582	16904907	17319514	17760555	16
45	16520898	16911613	17326662	17768142	15
46	16527220	16918326	17333798	17775740	14
47	16533548	16925046	17340941	17783343	13
48	16539883	16931772	17348091	17790955	12
49	16546224	16948504	17355249	17798575	11
50	16552571	16945244	17362415	17806203	10
51	16558925	16951990	17369587	17813838	9
52	16565286	16958743	17376767	17821481	8
53	16571642	16965495	17383954	17829132	7
54	16578026	16972270	17391148	17836792	6
55	16584406	16979044	17398350	17844460	5
56	16590792	16985824	17405560	17852135	4
57	16597184	16992611	17412776	17859818	3
58	16603584	16999406	17420000	17867509	2
59	16609989	17006208	17427231	17875209	1
60	16616401	17013017	17434469	17882917	0
	37	36	35	34	

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the complements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Secants.

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

	56	57	58	59	
0	17882917	18360816	18870800	19416039	60
1	17890632	18369014	18879589	19425445	59
2	17898356	18377251	18888389	19434862	58
3	17906089	18385497	18897196	19444290	57
4	17913830	18393753	18906018	19453727	56
5	17921579	18402017	18914846	19463175	55
6	17929337	18410291	18923685	19472635	54
7	17937102	18418574	18932534	19482114	53
8	17944876	18426865	18941393	19491595	52
9	17952658	18435165	18950261	19501076	51
10	17960448	18443454	18959139	19510578	50
11	17968247	18451792	18968027	19520091	49
12	17976054	18460120	18976926	19529615	48
13	17983869	18468456	18985834	19539150	47
14	17991693	18476802	18994752	19548697	46
15	17999525	18485157	19003680	19558254	45
16	18007365	18493521	19012618	19567822	44
17	18015214	18501895	19021516	19577401	43
18	18023071	18510278	19030523	19586991	42
19	18030936	18518670	19039491	19596592	41
20	18038811	18527072	19048468	19606204	40
21	18046693	18535483	19057455	19615827	39
22	18054584	18543903	19066453	19625462	38
23	18062482	18552332	19075461	19635107	37
24	18070389	18560770	19084480	19644765	36
25	18078305	18569217	19093509	19654434	35
26	18086229	18577674	19102549	19664114	34
27	18094161	18586139	19111598	19673805	33
28	18102102	18594614	19120658	19683507	32
29	18110051	18603098	19129727	19693220	31
30	18118009	18616591	19138807	19702945	30
	33	32	31	30	

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrant.

The degrees of the Quadrant for the Secants

of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant

	56	57	58	59	
30	18118009	18611591	19138807	19702945	30
31	18125975	18620094	19147897	19712680	29
32	18133950	18629606	19156998	19722428	28
33	18141934	18637127	19166109	19732186	27
34	18149926	18645658	19175231	19741956	26
35	18157927	18654198	19184362	19751738	25
36	18165937	18662748	19193504	19761531	24
37	18173956	18671507	19202656	19771335	23
38	18181984	18679875	19211818	19781141	22
39	18190021	18688452	19220990	19790968	21
40	18198065	18697038	19230172	19800808	20
41	18206118	18705634	19239365	19810658	19
42	18214179	18914239	19248569	19820320	18
43	18222249	18722854	19257783	19830393	17
44	18230328	18731480	19267008	19840277	16
45	18238416	18740115	19276242	19850172	15
46	18246513	18748760	19285488	19860079	14
47	18254618	18757414	19294744	19869997	13
48	18262732	18766078	19304010	19879927	12
49	18270854	18774752	19313287	19889068	11
50	18278986	18783436	19322574	19899820	10
51	18287126	18792130	19331872	19909784	9
52	18295276	18800833	19341181	19919760	8
53	18303434	18809546	19350501	19929748	7
54	18311601	18818268	19359831	19939749	6
55	18319776	18826999	19369172	19949760	5
56	18327961	18835741	19378524	19959784	4
57	18337154	18844492	19387886	19966820	3
58	18344356	18853252	19397260	19979868	2
59	18352567	18862021	19406644	19989928	1
60	18360816	18870800	19416939	20000000	0
	33	32	31	30	

The minutes of degrees of the Quadrant for the Secants of the complements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

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The degrees of the Quadrant for the Secants

	60	61	62	63	
0	20000000	20626654	21300545	22026892	60
1	20010083	20637484	21312206	22039475	59
2	20020179	20648338	21323882	22052074	58
3	20030285	20659184	21335570	22064690	57
4	20040404	20670054	21347275	22077322	56
5	20050534	20680937	21358993	22089970	55
6	20060676	20691834	21370727	22102635	54
7	20070832	20702744	21382475	22115316	53
8	20080995	20713667	21394238	22128014	52
9	20091172	20724603	21407016	22140728	51
10	20101361	20735554	21417808	22153459	50
11	20111562	20746517	21429615	22166204	49
12	20121776	20757494	21441438	22178971	48
13	20132001	20768484	21453275	22191751	47
14	20142239	20779488	21465128	22204548	46
15	20152489	20790505	21476995	22217361	45
16	20162751	20801535	21488877	22230191	44
17	20173035	20812579	21500774	22243038	43
18	20183321	20823636	21512686	22255902	42
19	20193619	20834706	21524612	22268782	41
20	20203930	20845791	21536553	22281680	40
21	20214252	20856888	21548509	22294595	39
22	20224588	20868000	21560481	22307526	38
23	20234936	20879125	21572467	22320474	37
24	20245296	20890264	21584469	22333439	36
25	20255669	20901416	21596487	22346420	35
26	20266054	20912582	21608520	22359419	34
27	20276452	20923761	21620568	22372434	33
28	20286863	20934955	21632631	22385466	32
29	20297286	20946162	21644710	22398418	31
30	20307721	20957383	21656804	22411584	30
	29	28	27	26	

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the Arches of the complements of the same Quadrant.

of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

	60	61	62	63	
30	20307721	20957383	21656804	22411584	30
31	20318170	20968618	21668913	22424667	29
32	20328630	20979867	21681038	22437768	28
33	20339192	20991130	21693178	22450886	27
34	20349587	21002406	21705334	22464022	26
35	20360084	21013696	21717505	22477175	25
36	20370594	21025001	21729691	22490346	24
37	20381116	21036319	21741893	22503543	23
38	20391751	21047651	21754111	22516748	22
39	20402198	21058997	21766344	22529965	21
40	20412758	21070357	21778593	22543201	20
41	20423331	21081731	21790858	22556358	19
42	20433916	21093119	21803138	22569723	18
43	20444514	21104522	21815434	22583025	17
44	20455126	21115938	21827745	22596336	16
45	20465750	21127368	21840072	22609663	15
46	20476387	21138814	21852415	22623009	14
47	20487037	21150273	21864774	22636372	13
48	20497700	21161747	21877149	22649754	12
49	20508376	21173235	21889539	22663152	11
50	20519064	21184737	21901946	22676569	10
51	20529765	21196253	21914369	22690004	9
52	20540479	21207783	21926808	22703456	8
53	20551205	21219328	21939263	22716924	7
54	20561945	21230887	21951734	22730414	6
55	20572697	21242460	21964220	22743919	5
56	20583463	21254048	21976722	22757443	4
57	20594242	21265650	21989240	22770984	3
58	20605033	21277267	22001775	22784543	2
59	20615837	21288899	22014325	22798120	1
60	20626654	21300545	22026892	22811726	0
	29	28	27	26	

The minutes of degrees of the Quadrant for the Secants of the complements of the Arches of the same Quadrant

of the complements of the Arches of the same Quadrant

The Table of Secants.

The degrees of the Quadrant for the Secants.

	64	65	66	67	
0	22811726	23662013	24585936	25593051	60
1	22825329	23676784	24602010	25610602	59
2	22838962	23691575	24618107	25628180	58
3	22852612	23706387	24634227	25645783	57
4	22866281	23721220	24650370	25663414	56
5	22879968	23736073	24696536	25681071	55
6	22893674	23750947	24682727	25698754	54
7	22907387	23765842	24698940	25716464	53
8	22921140	23780757	24715178	25734301	52
9	22934901	23795692	24731439	25751965	51
10	22948680	23810648	24747724	25769755	50
11	22962478	23825625	24764033	25787582	49
12	22976294	23840623	24780365	25805417	48
13	22990129	23805642	24796721	25823287	47
14	23003983	23870683	24813101	25841185	46
15	23017855	23885844	24829504	25859104	45
16	23031747	23900827	24845932	25877061	44
17	23045657	23915931	24862383	25895040	43
18	23059586	23931055	24879958	25913046	42
19	23073534	23946200	24895356	25931080	41
20	23087501	23961366	24911878	25949145	40
21	13101486	23976553	24928423	25967230	39
22	23115490	23991762	24944993	25985345	38
23	23129513	24006992	24961587	26003487	37
24	23143556	24022245	24978205	26021658	36
25	23157616	24037518	24994847	26039855	35
26	23171696	24052814	25011514	26058081	34
27	23185795	24068130	25028205	26076333	33
28	23199913	24083469	25044920	26094614	32
29	23214050	24098850	25061660	26112923	31
30	23228205	24114213	25078426	26131259	30
	25	24	23	22	

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrat.

The minutes of the degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrat.

of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

	64	65	66	67	
30	23228205	24114213	25078426	26131259	30
31	23242380	24129616	25095216	26149623	29
32	23205574	24145041	25112030	26168015	28
33	23270797	24160487	25128869	26186436	27
34	23285021	24175956	25145732	26204884	26
35	23299273	24191445	25162620	26223361	25
36	23313546	24206956	25179532	26241867	24
37	23327838	24222488	25196469	26260400	23
38	23342150	24238043	25213432	26278963	22
39	23356481	24253619	25230418	26297555	21
40	23370832	24269217	25247431	26316176	20
41	23385203	24284838	25264468	26334825	19
42	23399593	24300481	25281531	26353503	18
43	23414003	24316147	25298620	26372209	17
44	23428433	24331835	25315734	26390945	16
45	23442882	24347546	25332874	26409709	15
46	23457351	24363281	25350035	26428502	14
47	23471840	24379038	25367219	26447323	13
48	23486348	24394818	25384445	26466174	12
49	23500876	24410620	25401687	26485053	11
50	23515424	24426446	25418956	26503962	10
51	23529992	24442294	25436250	26522890	9
52	23544580	24458164	25453570	26541867	8
53	23559188	24474056	25470915	26560863	7
54	23573817	24489973	25488286	26579889	6
55	23588565	24505908	25505683	26598945	5
56	23603134	24521869	25523005	26618030	4
57	23617822	24537851	25540553	26637145	3
58	23632532	24553837	25558027	26656251	2
59	23647262	24569885	25575526	26675466	1
60	23662013	24585930	25593051	26694672	0
	25	24	23	22	

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrant.

of the complements of the Arches of the same Quadrant.

The Table of Secants.

The degrees of the Quadrant for the Secants

	68	69	70	71	
0	26694672	27904284	29238045	30715531	60
1	26713907	27925445	29261433	30741500	59
2	26733172	27946643	29284861	30767516	58
3	26752467	27967873	29308328	30793579	57
4	26771791	27989139	29331835	30819689	56
5	26791145	28010440	29355382	30845846	55
6	26810529	28031776	29378970	30872051	54
7	26829942	28053147	29402599	30898304	53
8	26849390	28074553	29426268	30924605	52
9	26868867	28095994	29449978	30950953	51
10	26888373	28117469	29473728	30977350	50
11	26907910	28138980	29497519	31003793	49
12	26927479	28160527	29521350	31030285	48
13	26947078	28182108	29545222	31056824	47
14	26966709	28203725	29569136	31083412	46
15	29986370	28225378	29593090	31110047	45
16	27006062	28247067	29617087	31136731	44
17	27025785	28268793	29641124	31163462	43
18	27045539	28290553	29665204	31190241	42
19	27065323	28312349	29689326	31217019	41
20	27085138	28334181	29713488	31243945	40
21	27104985	28356049	29737692	31270871	39
22	27124864	28377954	29761938	31297848	38
23	27144774	28399894	29786227	31324873	37
24	27164717	28421871	29810558	31351948	36
25	27184690	28443884	29834931	31379072	35
26	27204686	28465934	29859347	31406247	34
27	27224734	28488021	29883705	31433472	33
28	27244804	28510144	29908306	31460747	32
29	27264906	28532304	29932850	31488072	31
30	27285040	28554501	29957438	31515448	30
	21	20	19	18	

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrat.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrat.

The degrees of the Quadrant for the Secants.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

	68	69	70	71	
30	27285040	28554501	29957438	31515448	30
31	27305205	28576735	29982069	31542873	29
32	27325402	28599007	30006743	31570349	28
33	27345631	28621310	30031460	31597875	27
34	27365893	28643662	30056220	31625453	26
35	27386186	28666045	30081023	31653080	25
36	27406513	28688467	30105870	31680758	24
37	27426872	28710925	30130760	31708486	23
38	27447264	28733422	30155714	31736265	22
39	27467688	28755956	30180672	31764094	21
40	27488145	28778549	30205694	31791974	20
41	27508635	28801139	30230760	31819906	19
42	27529157	28823787	30255871	31847891	18
43	27549722	28846473	30281026	31875929	17
44	27570301	28869196	30306226	31904019	16
45	27590922	28891957	30331460	31932164	15
46	27611578	28914756	30356759	31960358	14
47	27632266	28937594	30382092	31988606	13
48	27652985	28960471	30407470	32016909	12
49	27673745	28983386	30432893	32045263	11
50	27694535	29006340	30458361	32073672	10
51	27715358	29029332	30483873	32102132	9
52	27736215	29052363	30509430	32130649	8
53	27757105	29075435	30535033	32159212	7
54	27778029	29098546	30560682	32187832	6
55	27798987	29121697	30586375	32216504	5
56	27819978	29144888	30612115	32245231	4
57	27841003	29168118	30637890	32274012	3
58	27862060	29191388	30663732	32302846	2
59	27883156	29214697	30689608	32331735	1
60	27904284	29238045	30715531	32360678	0
	21	20	19	18	

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrant.

of the complements of the Arches of the same Quadrant.

The Table of Secants.

The degrees of the Quadrant for the Secants

	72	73	74	75	
0	32360678	34203038	36279559	38637042	60
1	32389676	34235609	36316402	38679033	59
2	32418726	34268245	36353333	38721117	58
3	32447837	34300947	36390323	38763296	57
4	32477001	34333716	36427401	38805571	56
5	32506219	34366553	36464558	38847941	55
6	32535494	34399452	36501793	38890408	54
7	32564823	34432420	36539107	38932971	53
8	32594209	34465456	36570511	38975632	52
9	32623651	34498557	36613973	39018390	51
10	32653148	34531726	36651525	39061246	50
11	32682701	34564959	36689156	39104200	49
12	32712311	34598259	36726868	39147252	48
13	32741977	34631626	36764660	39190423	47
14	32771699	34665061	36802533	39233653	46
15	32801478	34698564	36840488	39277002	45
16	32831314	34732135	36878524	39320449	44
17	32861207	34765775	36916641	39363994	43
18	32891157	34799483	36954842	39407640	42
19	32921165	34833259	36993127	39451384	41
20	32951231	34867105	37031496	39495228	40
21	32981355	34901024	37069947	39539172	39
22	33011537	34935005	37108402	39583218	38
23	33041776	34966052	37147101	39627364	37
24	33072074	35003172	37185803	39671613	36
25	33102431	35037361	37224589	39715965	35
26	33131846	35071621	37263459	39760420	34
27	33163320	35105952	37302413	39804979	33
28	33193853	35140354	37341453	39849642	32
29	33224444	35174826	37380577	39894411	31
30	33255094	35209369	37419788	39939286	30
	17	16	15	14	

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the, cõplements of the Arches of the same Quadrant.

The Table of Secants.

of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

	72	73	74	75	
30	33255094	35209369	37419788	39939226	30
31	33285803	35243981	37459081	39984263	29
32	33316571	35278664	37498460	40029344	28
33	33347398	35313418	37537923	40074528	27
34	33378286	35348244	37577471	40119816	26
35	33409132	35383140	37617104	40165289	25
36	33440240	35418110	37656824	40210709	24
37	33471307	35453152	37696632	40256316	23
38	33502436	35488268	37736518	40302033	22
39	33533625	35523456	37776513	40347858	21
40	33564875	35558718	37816588	40393791	20
41	33596187	35594052	37856751	40439834	19
42	33627561	35629460	37897004	40485985	18
43	33658998	35664940	37937146	40532245	17
44	33690497	35700494	37977779	40578613	16
45	33722059	35736121	38018300	40625091	15
46	33754683	35771822	38058912	40671678	14
47	33785370	35807597	38099614	40718374	13
48	33817120	35843447	38140406	40765180	12
49	33848934	35879373	38181288	40812093	11
50	33880813	35915374	38222261	40859121	10
51	33912753	35951451	38263324	40906259	9
52	33944756	35987602	38304479	40953510	8
53	33976821	36023829	38345725	41004876	7
54	34008950	36060132	38387064	41048358	6
55	34041141	36096510	38428495	41095957	5
56	34073395	36132966	38470019	41143668	4
57	34105712	36169497	38511635	41191492	3
58	34138091	36206107	38553344	41239431	2
59	34170523	36242794	38595146	41287425	1
60	34203038	36279559	38637042	41335654	0
	17	16	15	14	

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrant.

of the complements of the Arches of the same Quadrant.

The Table of Secants.

The degrees of the Quadrant for the Secants.

	76	77	78	79	
0	41335654	44454097	48097335	52408433	60
1	41383937	44510183	48163151	52486983	59
2	41432338	44566415	48229350	52565774	58
3	41480856	44622793	48295633	52644807	57
4	41529492	44679318	48362102	52724084	56
5	41578245	44735990	48428756	52803604	55
6	41627117	44792810	48495599	52883368	54
7	41676108	44849777	48562631	52963377	53
8	41725219	44906892	48629854	53043632	52
9	41774450	44964155	48697269	53124134	51
10	41823802	45021567	48764877	53204885	50
11	41873273	45079129	48832678	53285884	49
12	41922863	45136843	48900673	53367134	48
13	41972573	45194707	48968853	53448635	47
14	42022405	45252726	49037249	53530390	46
15	42072357	45310898	49105830	53612399	45
16	42122431	45369223	49174607	53694666	44
17	42172625	45427703	49243590	53777191	43
18	42222942	45486338	49312751	53859976	42
19	42273380	45545127	49382118	53943022	41
20	42323942	45604073	49451684	54026331	40
21	42374627	45663175	49521449	54109903	39
22	42425439	45722435	49591416	54193739	38
23	42476377	45781853	49661584	54277840	37
24	42527442	45841429	49731956	54362207	36
25	42578635	45901164	49802532	54446842	35
26	42629957	45961059	49873313	54531744	34
27	42681409	46021115	49944301	54616915	33
28	42732991	46081333	50015497	54702356	32
29	42784705	46141715	50086901	54788068	31
30	42836551	46202261	50158514	54874053	30
	13	12	11	10	

The degrees of the Quadrant for the Secants.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrãt.

of the Arches of the same Quadrant.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

	76	77	78	79	
30	42836551	46202261	50158514	54874053	30
31	42888527	46262969	50230335	54960312	29
32	42940631	46323841	50302367	55046847	28
33	42992865	46384877	50374610	55133659	27
34	43045229	46446076	50447065	55220751	26
35	43097722	46384877	50519732	55308122	25
36	43150347	46446076	50592614	55395775	24
37	43203103	46630665	50665711	55483710	23
38	43255992	46692527	50739024	55571930	22
39	43309012	46754555	50812553	55660434	21
40	43362166	46816752	50886299	55749226	20
41	43415454	46879117	50960263	55838300	19
42	43468877	46941653	51034447	55927677	18
43	43522435	47004361	51108850	56017340	17
44	43576129	47067242	51183475	56107297	16
45	43629959	47130297	51258321	56197549	15
46	43683925	47193526	51333391	56288099	14
47	43738728	47256930	51408684	56378948	13
48	43792268	47320509	51484204	56470097	12
49	43846646	47384264	51559951	56561548	11
50	43901162	47448195	51635936	56653302	10
51	43955817	47512302	51712129	56745360	9
52	44000612	47576586	51788563	56837723	8
53	44065548	47641048	51865227	56930392	7
54	44120625	47705689	51942124	57023369	6
55	44175844	47770510	52019254	57116653	5
56	44231207	47835511	52096618	57210246	4
57	44286712	47900693	52174216	57304150	3
58	44342362	47966058	52252051	57398367	2
59	44398156	48031605	52330123	57492896	1
60	44454097	48097335	52408433	57587740	0
	13	12	11	10	

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrant.

of the complements of the Arches of the same Quadrant.

The Table of Secants.

The degrees of the Quadrant for the Secants.

	80	81	82	83	
0	57587740	63924495	71852975	82055127	60
1	57682901	64042118	72002006	82249986	59
2	57778381	64160180	72151659	82445779	58
3	57874180	64278683	72301942	82642513	57
4	57970302	64397632	72452863	82840196	56
5	58066748	64517028	72604421	83038833	55
6	58163520	64636873	72756618	83238436	54
7	48260619	64757168	72909461	83439009	53
8	58358049	64877918	73062954	83640561	52
9	58455810	64999124	73217100	83843097	51
10	58553903	65120789	73371903	84046626	50
11	58652333	65242916	73527367	84251153	49
12	58751099	65365508	73683499	84456680	48
13	58850205	65488566	73840302	84663212	47
14	58949653	65612095	73997782	84870760	46
15	59049444	65736097	74155942	85079327	45
16	59149581	65859675	74314786	85288957	44
17	59250065	65985531	74474318	85499628	43
18	59350898	66110967	74634544	85711347	42
19	59452082	66246886	74795468	85924121	41
20	59553618	66363291	74957095	86137958	40
21	59655506	66490185	75119429	86352864	39
22	59757728	66617572	75282475	86568849	38
23	59860346	66745453	75446238	86785921	37
24	59963291	66873831	75610721	87004089	36
25	60066612	67002708	75775928	87223362	35
26	60170285	67132088	75941864	87443750	34
27	60274319	67261972	76108533	87665261	33
28	60378718	67392365	76275941	87887909	32
29	60483482	67523270	76444091	88111704	31
30	60588615	67654691	76612989	88336657	30
	9	8	7	6	

The degrees of the Quadrant for the Secants.

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrat.

of the Arches of the same Quadrant.

	80	81	82	83	
30	60588615	67654691	76612989	88336657	30
31	60694116	67786629	76782641	88562776	29
32	60799995	67919089	76953050	88790069	28
33	60906240	68053073	77124223	89018543	27
34	61012875	68185585	77296165	89248201	26
35	61119888	68319630	77468882	89479054	25
36	61227277	68454208	77642381	89711108	24
37	61335043	68589313	77816665	89944373	23
38	61443202	68724977	77991740	90178856	22
39	61551749	68861175	78167612	90414568	21
40	61660686	68997926	78344287	90651519	20
41	61770013	69135315	78521769	90889717	19
42	61879735	69273018	78700066	91129181	18
43	61989853	69411465	78879183	91369917	17
44	62100367	69550434	79059128	91611941	16
45	62211280	69689965	79239905	91855265	15
46	62322594	69830055	79421520	92099899	14
47	62434312	69970726	79603976	92345849	13
48	62546437	70111967	79787381	92593126	12
49	62658971	70253786	79971439	92841739	11
50	62771918	70396188	80156456	93091699	10
51	62885274	70539174	80342336	93342963	9
52	62999049	70682751	80529087	93595620	8
53	63113241	70826919	80716713	93849647	7
54	63227855	70971684	80905219	94105066	6
55	63342890	71117047	81094612	94361964	5
56	63458352	71263014	81284899	94620181	4
57	63574240	71409586	81476087	94879901	3
58	63690559	71556766	81668183	95141050	2
59	63807309	71704564	81861195	95403639	1
60	63924495	71852975	82055127	95667689	0
	6	8	7	6	

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrant.

The Table of Secants.

The degrees of the Quadrant for the Secants

	84	85	86	
0	95667689	114737188	143355808	60
1	95933204	115119970	143954694	59
2	96200195	115505313	144558602	58
3	96468673	115893242	145167595	57
4	96738655	116283797	145781740	56
5	97010253	116676991	146401101	55
6	97283267	117072851	147025745	54
7	97557932	117471403	147655740	53
8	97834057	117872815	148291169	52
9	98111843	118276840	148932108	51
10	98391211	118683794	149578791	50
11	98672171	119093414	150230942	49
12	98954738	119506013	150888966	48
13	99236930	119921335	151552578	47
14	99524766	120339695	152222283	46
15	99812250	120760985	152897946	45
16	100101400	121185232	153579394	44
17	100392329	121612482	154267179	43
18	100684851	122042752	154961155	42
19	100979193	122476076	155661396	41
20	101275259	122912485	156368008	40
21	101572962	123352014	157081063	39
22	101872522	123794696	157800648	38
23	102173854	124240732	158526854	37
24	102476971	124689836	159259771	36
25	102781890	125142353	159999560	35
26	103088639	125598007	160746121	34
27	103397202	126057149	161499724	33
28	103707656	126519656	162260744	32
29	104019959	126985568	163028671	31
30	104334254	127454936	163804188	30
	5	4	3	

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrant.

	84	85	86	
30	104334254	127454936	163804188	30
31	104650345	127927785	164586836	29
32	104968474	128404152	165377268	28
33	105288542	128884078	166175067	27
34	105610566	129367704	166980877	26
35	105934564	129854921	167794536	25
36	106260557	130345812	168615879	24
37	106588558	130840395	169445585	23
38	106918589	131338917	170283495	22
39	107250680	131841076	171129820	21
40	107584955	132347264	171984431	20
41	107921201	132857174	172847712	19
42	108259554	133371390	173709700	18
43	108600151	133889600	174600528	17
44	108942779	134411312	175490331	16
45	109287702	134937471	176389247	15
46	109634817	135467749	177297417	14
47	109984143	136002235	178215000	13
48	110335695	136540955	179142131	12
49	110689503	137083887	180078954	11
50	111045597	137631223	181025951	10
51	111403988	138183016	181982628	9
52	111764699	138739177	182949802	8
53	112127750	139299830	183926988	7
54	112493167	139865032	184915009	6
55	112861097	140435034	185913698	5
56	113231316	141009514	186922883	4
57	113604936	141588910	187943432	3
58	113979204	142172885	188975184	2
59	114356941	142761897	190018342	1
60	114737188	143355808	191073059	0
	5	4	3	

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrant.

of the complements of the Arches of the same Quadrant

The Table of Secants.

The degrees of the Quadrant for the Secants

	87	88	89	
0	191073059	286537048	572987998	60
1	192139567	288943841	582696234	59
2	193218044	391391404	592740072	58
3	194308693	293880683	603139919	57
4	195411723	296413087	613907444	56
5	196527729	298990299	625070305	55
6	197656181	301611807	636642580	54
7	198797665	304279687	648655621	53
8	199952408	306996123	661126359	52
9	201120639	309760533	674090521	51
10	202303011	312576192	687573461	50
11	203498943	315442491	701612741	49
12	204709121	318361849	716229489	48
13	205934200	321336774	731453951	47
14	207173596	324366765	747358168	46
15	208428431	327455509	763965262	45
16	209698119	330601545	781323254	44
17	210983811	333811800	799493739	43
18	212284914	337082830	818524878	42
19	213602421	340419652	838490069	41
20	214936837	343823403	859453551	40
21	216287319	347294586	881484374	39
22	217655350	350837799	904682629	38
23	219040792	354454051	929134899	37
24	220443981	358145679	954945691	36
25	221865261	361914968	982231437	35
26	223305005	365763113	1011112129	34
27	224763453	369695332	1041753449	33
28	226241278	373713015	1074309940	32
29	227738558	377818975	1108967170	31
30	229255785	382016194	1145934768	30
	2	1	0	

The degrees of the Quadrant for the Secants

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrant.

	87	88	89	
30	229255785	382016194	1145934768	30
31	230793360	386307709	1185438054	29
32	232351718	390696734	1227777193	28
33	233931261	395186630	1273252703	27
34	235532422	399780916	1322226495	26
35	237156211	404483275	1375118522	25
36	238801972	409397566	1432297932	24
37	240470730	414227875	1494678912	23
38	242163582	419278406	1562622042	22
39	243879838	424453607	1637036239	21
40	245621193	429758156	1718892212	20
41	247386980	435196961	1809365043	19
42	249178956	440775230	1909891150	18
43	250996450	446498305	2022234532	17
44	252841285	452371994	2148642981	16
45	254713463	458402271	2291895669	15
46	256612911	464595485	2455554199	14
47	258541565	470958329	2644450861	13
48	260499426	477497828	2864894681	12
49	262487160	484221619	3125282743	11
50	264505458	491139838	3437843546	10
51	266554348	498256113	3819709423	9
52	268635944	505581634	4297193536	8
53	270750304	513128395	4911255640	7
54	272898206	520901152	5729642566	6
55	275080457	528915798	6875687278	5
56	277297985	537178089	8594018365	4
57	279551349	545702599	11458691197	3
58	281841763	554505091	17188036598	2
59	284170013	563593031	34376072269	1
60	286537048	572987098	INFINITA	0
	2	1	0	

The minutes of the degrees of the Quadrant for the Secants of the Arches of the same Quadrant.

The minutes of degrees of the Quadrant for the Secants of the cõplements of the Arches of the same Quadrant.

of the complements of the Arches of the same Quadrant.

A plaine Treatiſe of the firſt principles of Coſmographie, and ſpecially of the Spheare, repreſenting the ſhape of the whole world:

Together with all the chiefeſt and moſt neceſſarie vſes thereof, written by M. *Blundevill* of Newton Flotman, *Anno Dom.* 1594.



The heauens declare the glory of God, and the firmament ſheweth his handy worke. pſal. 19.

LONDON

Printed by *Iohn Windet*, 1597.

The exposition of certaine termes or principles of *Geometrie*.

MInding to treate of the principles of Cosmographie and especially of the Sphere, I think it good first to expound vnto you certaine termes of Geometry, without the which the vnlearned shall hardly vnderstand the contents of this Treatise, which tearmes are certaine principles of Geometrie, called definitions. For there are but three kinds of principles, whereon the demonstration of all Geometricall conclusions dependeth: that is, definitions, petitions, and maxims, but I minde here to deale onely with certaine definitions. Whereof I wil set downe as many as I thinke needfull for this purpose, in such order as followeth.

1 A point called in Latine punctus, is a thinke supposed to bee indiuisible, hauing neither length, breadth, nor depth, as the point or pricke a.

A

2 A line called in Latine linea, is a supposed length, hauing neither breadth nor thicknesse, as the line a.b.

A——B

3 The endes or bounds of a line, are two pointes, and of lines some be right, and some be crooked.

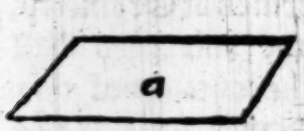


Linea tortuola.



Linea spiralis



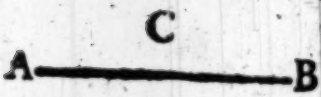


Couexe.

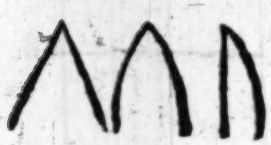


Concaue.





Right. Crooked. Mixt.



4 A right line is that which goeth right from one point to another, and not bowing. lie as doth the line c. d. but so straight as is possible, as the line a. b. Againe the crooked line is eyther a whole Circle, or portion of a Circle, or else goeth winding in and out, as a serpent called in Latine Linea tortuosa, or else winding about like the shell of a Snaile, called of the Latines, linea Spiralis, as these figures heere doe shew.

5 Superficies or vpperface, is that which onely hath length and breadth, without depth, which is twofould, that is to say, plaine and crooked.

6 The bounds of superficies are lines.

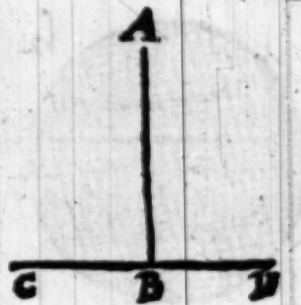
7 A plaine superficies is that which lyeth straight betwixt his lines, as the figure a. & a crooked superficies is that which goeth bowing and lyeth not straight betwixt his lines as the figure b. Againe superficies being considered in an hollow bodie, as a barrell, tunne, or vault, may be deuided into two other kinds, that is Conuexe, and Concaue, for the vpper part of such vault is said to be conuexe, & the inward part concaue, as the figure b sheweth.

8 A plaine Angle is when two lines being drawne vpon a plaine superficies not directly one against another, but so as by meeting or touching one another in one selfe point, they may make a plaine Angle, as the Angle a. For if two lines be drawne directly one against another, though they meete in one point, yet they make no Angle, but rather one selfe line as the two lines a. b. meeting in the point c.

9 Of plaine Angles, some are called right line angles, because that both the lines where of it consisteth are right, and some are called

called crooked line angles, because that both lines are crooked, & some are said to be mixt, because the one line is crooked and the other right, as you may perceiue by the three sundry shapes thereof made in the Margent.

10 If one right line standing vpon another right line do make two equall angels, that is to say, of ech side one, then eyther of those Angles that is right Angle, and the line so standing vpon his fellow, is called the perpendicular or plumbe line, as the line a.b. standing vpon the line c.d,



11 A blunt Angle, is that which is greater then a right Angle, as the Angle e.



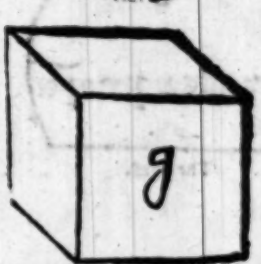
12 A sharpe Angle, is that which is lesser then a right Angle, as f. so as there be in all three Angles, that is right, blunt, and sharpe, in Latine rectus, obtusus, & acutus: And besides these Angles, there be also certaine Spherical, that is to say, round Angles, which consist of two circular lines drawne vpon a Spherical superficies, which doe crosse one another in some point, either rightly, or obliquely: if rightly, then they make right Angles, on ech side of the point where they crosse, as the figure E. sheweth, if obliquely, then they make sharpe Angles of the inside, and blunt Angles on the out side of the point, where they crosse as the figure F. doth partly shew, for such Angles cannot be so well described in Plano, as vpon the superficies of some Spherical body.







13 A terme called in Latine terminus, is the bound or limite of any thing, as pointes are the bounds of lines, and lines the bounds of superficies, & superficies the bounds of a body, which is that which hath imaginatiuely, but not materially, both length, bredth and depth, and if such body haue many faces

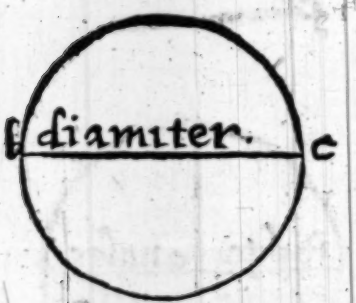




1



Circumference

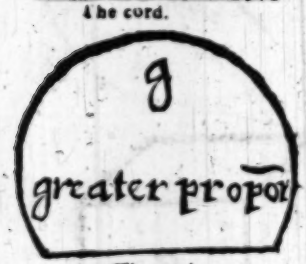




f



The cord.



The cord.

or sides, then it is bounded with many superficieses, as the figure g. made like a fire square-dye. But if such body be rounde as a bowle, Sphere, or Globe, then it is bounded or couered with one superficies onely, as the figure H. doth shewe.

14 A figure is that which is comprehended within one bound, or many bounds.

15 A circle is a plaine figure bounded with one circular line, which is called the circumference, vnto the which as many right lines as are drawne from the point standing in the midst, are all equall one to the other, that is to say, one is as long as an other, as the figure I. here doth shew.

16 And the middle point of a Circle is called the Center, as the point A. in the figure I.

17 The Diameter of the Circle, is a right line passing through the Center, from one side of the Circumference to the other, which deuideth the Circle into two equall parts, as the line B.C.

18 A Semicircle is a figure, contained within the Diameter and halfe the Circumference of a Circle as the figure D.C.E.

19 The portion of a Circle, is a part of a Circle, greater or lesser then the Semicircle, as the figures F. and G. doe shewe, the right line in eyther of which figures is called in Latine chorda, in English the string, and the Cicular line in Latine in called arcus in English the bowe, but the Diameter is alwaies the greatest chord in any Circle.

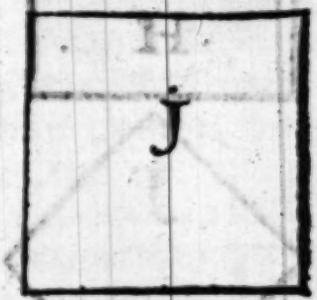
20 Right line figures, as those which are bounded with right lines.

21 Tri-

21 Triangles or three cornerd figures, are those which are bounded with three right lines as the figure H.



22 Foure Square figures, are those which are bounded with four right lines, as the figure I.



23 Many square figures, are those which are bounded with more right lines then foure as K.



24 Of Triangles or three cornerd figures, there be fiue kindes, whereof the first is called Isoplurus, hauing three equall sides and three equal Angles as A.



25 The second is called Isosceles, hauing but two equall sides and angles as B.



26 The third called scalenos hauing no side equall one with the other, but one shorter or longer then another, as C.



27 The fourth is called Orthogonius, hauing one right angle, as D.



28 The fift is called ampligonius, because it hath one blunt Angle, as E.



29 The sixt is called oxigonius, because it hath three sharpe Angles, but not equall sides as F.

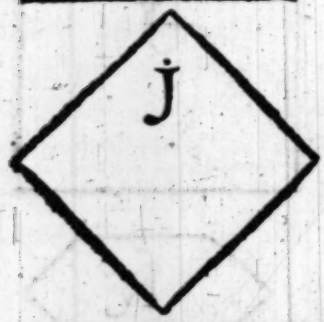




30. Of foure square figures there is one first foure square, hauing foure equall sides, and is right angled as G.



31 Another is called a long Square, which is right angled, but not hauing foure equall sides, as *H*.



32 There is another called rombus, that is to say a Turbut, in shape like to a Diamãt, which hath foure equall sides, but is not right angled, as I.

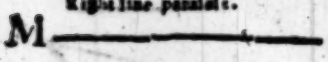


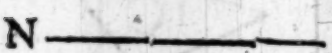
33 There is another called romboides, which though it hath sides and angles one right against another, yet hath it neyther foure equall sides, nor yet is right angled, as K.



34 All other kinds of foure squares are called trapezia, as L. and such like.

Right line paralels.





35 Paralels are twoo right lines equally distant one from another, which beeing drawne foorth infinitely, would neuer touch or meete one another in any parte, as the two lines M. N. And though the lines bee circular, yet if they be equally distant in all places one from another, they are also called paralels, as the figure P. sheweth, yea though the lines be winding in and out as Serpents. if they bee equally distant in all places one from another, they are paralels as well as they were right lines as the figure Q. sheweth.

Circular paralels.





Serpentine paralels.

The order and Contents of this Treatise, touching the first principles of Cosmography, and specially of the Spheare.

HAuing set downe the exposition of certaine termes of Geometry, for the better vnderstanding of this Treatise, I do first deuise what Conmography is, and therewith doe briefly showe what Sciences it comprehendeth, and who were first inuentors thereof: That done, because the Spheare doth represent the shape of the whole worlde, I doe define what a Spheare is, and then I doe deuide the worlde into two essentiall partes, that is, the Celestiall and Elementall part, according to which two partes I do also diuide this Treatise into two Bookes, the first whereof treateth of the Celestiall part, and the seconde of the Elementall part of the worlde, with what order the Chapters of each booke hereafter following, doe plainely shew.

The Chapters and Contents of the first booke.

OF Cosmography, what it is, and what kinde of Sciences it comprehendeth, and who were first inuentors thereof chap. 1.

The definition of a Spheare, and of the vnitie, roundnesse, and capacitie of the worlde, also of the Pole and Axeltree thereof. Chap. 2.

Of the diuision of the world, and of the two Essential parts thereof, and what things ech part containeth. chap. 3.

A figure of the whole world, wherein are set foorth the two Essentiall partes before mentioned, that is to say, the eleauen heauens and the foure Elements.

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The first part of the Spheare.

Of Cosmographie, what it is, and what kinds of Sciences it comprehendeth, and who were first inuentors thereof.

Cap. 1.

What is Cosmography?

Cosmography is the description of the whole world, that is to say, of heauen and earth, and all that is contained therein.

What speciall kindes of knowledge are comprehended vnder this Science.

These foure, Astronomie, Astrologie Geographie, and Chorographie.

What is Astronomy?

Astronomy is a Science, which considereth and describeth the magnitudes and motions of the celestiall or superiour bodies.

Which call you superiour bodies?

The Spheares or Heauens, and the Starres as well fixed as moueable, which we shall define hereafter in their proper places.

What is Astrologie?

It is a Science which by considering the motions, aspects, and influences of the starres, doth foretell and prognosticate things to come.

What is Geographie?

It is a knowledge teaching to describe the whole earth, and all the places contained therein, whereby vniuersall Maps and Cardes of the earth and sea are made.

What is Chorography?

It is the description of some particular place, as Region, Ile, Citie, or such like portiõ of the earth seuered by it self frõ the rest.

Who

Who were first inuentors of these Sciences.

Some say that Atlas was the first inuentor, whome the Poets faine to beare vp the heauens with his shoulders, hauing his head placed in the North Pole, and his feete in the South Pole, and his right hand bearing the East part, and his left hand the West part of the world. Albeit that some apply this fiction of the Poets to an high mountain in Affrica called Atlas, which for his great height surmounting the cloudes, is saide to beare vp the skies. But some say that Adam our first Parent, was the first inuentor thereof: And some others affirme that Abraham was the first inuentor thereof. But whosoeuer was the first inuentor, it well appeareth by Ptolomy his booke, called Almagesti, that he hath beene no small furtherer thereof, and since his time in these latter dayes Gēorgius Purbacchius, Iohannes de Monte Regio, Copernicus, and diuers others haue learnedly treated thereof. But leauing to speake of the first inuentors, or of the furtherers of these sciences, I will speake of the shape, capacitie, and vnitie of the world, and because the shape thereof is likned to a rounde bodie called a Spheare, I will first define what a Spheare is.

The definition of a Spheare, and of the vnitie, roundnesse, and capacitie of the worlde, also of the Poles and axeltree thereof.

Cap. 2.

WHat is a Spheare?

A Spheare is a round body, contained or couered with one onely superficies or vpper face, in the midst of which body is a point or pricke, called the center, from which all right lines being drawne to any part of the superficies or vpper face therof, are of equal length, as you may perceiue by this figure heere following, the Centre whereof is marked with the letter A.

And



And this Spheare before defined representeth the frame of the whole worlde, containing all thinges, and is contained of none.

How prooue you that there is but one world?

By the authoritie of Aristotle, who saieth, that if there were any other world out of this, then the earth of that world would moue towardes the Centre of this world, which cannot be, vnlesse it should first ascend from his owne Centre to the superficies or vpperface of the same, which is against nature, for euery heauie thing naturally tendeth downeward, and euery light thing vpward, which common experience sheweth: for a stone being cast vpwardes, will fall downewardes, and the flame of a candle being turned downewarde, will fly vpward.

How proue you the frame of the world to be round?

By three reasons, First by comparison, for the likenes, which it hath with the chiefe Idea or shape of Gods minde, which hath neither beginning nor ending, and therefore is compared to a Circle. Secondly by aptnesse as well of moning as of containing, for if it were not round of shape, it should not be so apt to turne about as it continually doth, nor to containe so much as it doth, for the round figure is of greatest capacitie and containeth most. Thirdly, necessitie prooueth it to be round, for if it were with Angles or corners, it should not bee so apt to turne about, and in turning about, it should leaue voide and emptie places, which nature abhorreth, for no place by nature can be without a bodie, nor a bodie without a place.

Wherupon is this Spheare or great round frame turned?

Vpon two most firme and immoueable hookes called in Latine Cardines mundi, and in Greeke Poli, deriued of the verbe Polo, which is as much to say, as to turne, for as a doore turneth vppon his hookes, so the world turneth vpon his two Poles, whereof the one is fixed in the North, and the other in the South, & the North pole is called in Latine Polus arcticus, and the South pole is called Antarcticus, through which Poles from the one to the other passeth a right immaginatiue line called of the Astronomers

the Axletrée of the worlde, about the which the worlde continually turneth like a Cart whéele, which you may sée liuely expressed in a materiall Spheare made for the purpose, for in Plano it cannot be so well described.

Of the diuision of the world, and of the two essential parts thereof, and what things ech part containeth.

Cap. 3.

HOw is the world deuided?

Most writers doe make a twofold diuision thereof, that is according to substance, and according to accidents, which accidents because the are none other thinge, but points, lines, and Circles, and so incident and necessarily belonging (by position though not by nature) to the substantiall parts, as the one can not bee described without the other, neither the subiect without the accidents, nor the accidents without their subiect, I will therefore make but one diuision of the worlde, diuiding the same into two essentiall parts, that is, the celestiall part, and the Elementall part, in the description of which parts, it shal also plainely appeare what those lines and Circles be, and to what end they serue.

What doth the celestiall part containe?

The eleuen Heauens and Spheares.

Make you no difference betwixt these Spheares, and the great Spheare which you last defined to bee couered with one superficies or vpperface.

Yes verily, for these haue two superficies or vpper faces, that is, the Conuexe and Concaue.

Which call you Conuexe and which Concaue?

The Conuexe is the outermost vpperface of any thing that is round, and therewith hollow, as of an ouen or vault, and the Concaue is the innermost or hollow superficies of the saide ouen or vault, or of any such like round bodie hauing concauitie or hollownesse.

Which

Which be those eleauen Spheares or Heauens whereof you did last speake?

In ascending orderly vpwardes from the Elements they bee these, The first is the Spheare of the Moone, The seconde the Spheare of Mercury, The third the Spheare of Venus, The fourth the Spheare of the Sunne, The fift the Spheare of Mars, The sixt the Spheare of Iupiter, the seauenth the Spheare of Saturne, The eight the Spheare of the fixed Starres, commonly called the firmament. The ninth is called the second moueable or Christall heauen, The tenth is called the first moueable, and the eleuenth is called the Emperiall heauen, where God and his Angels are said to dwell.

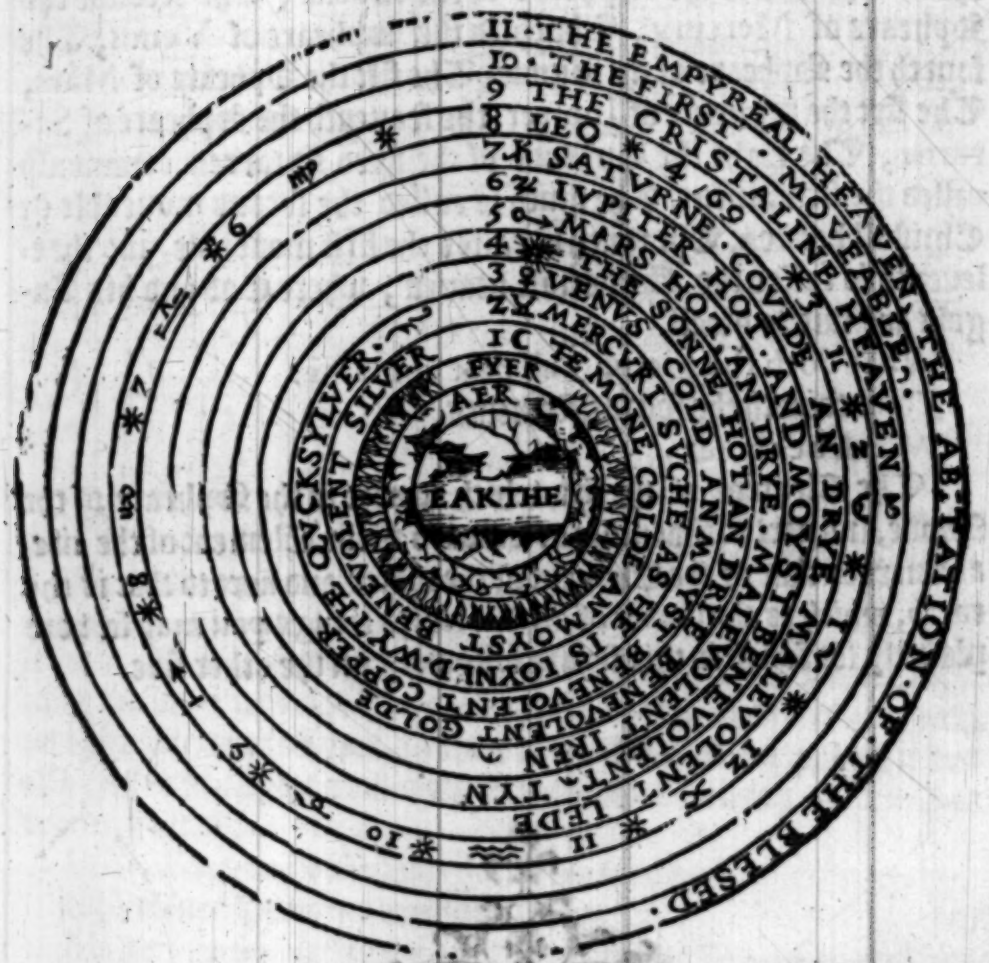
What doth the Elementall part containe?

It containeth the foure Elements.

Which be those?

The Element of the fire which is next to the Spheare of the Moone, and next to that more downward is the Element of the aire, and next to that is the Element of the water, and next to that is the earth, which is the lowest of all. All which things you may see here plainely set forth in this figure following on the other side.

A figure of the whole world, wherein are set forth the two essentiall parts before mentioned, that is to say, the eleuen heauens and the foure Elements.



A demonstration to proue the pluralitie of the heauens.

Cap. 4.

HOw is it to bee prooued that there is such multiplicitie of heauens, sith to the eye it seemeth one whole bodie?

If there were not diuers heauens and diuers motions, there shoulde neither bee generation nor corruption of any thing, for all things then should bee as one, and euer

euer in one estate, but besides that reason men haue found out by experience in obseruing the diuers rising and setting of diuers wandring starres called the Planets, that euery such Planet hath a seuerall Spheare or heauen by it selfe, for otherwise they should continually keepe the places as the fixed starres doe, which doe moue altogether according to the mouing of the viii. heauen wherein they are placed.

I graunt that there may bee diuers heauens or Spheares. But how prooue you that there be tenne moueable heauens, besides the imperiall heauen before mentioned, and specially fith of the olde writers, some affirme that there bee but nine, and some haue saide that there bee no more then eight?

The latter writers haue found by good obseruation (as they say) that the firmament or eight heauen hath three seuerall motions wherewith it is moued and turned about, which coulde not be, vnlesse there were two moueable heauens higher then that, as shall bee declared when wee come to shew the threefold motion of the saide eight heauen, for heere I minde briefly to describe vnto you all the heauens, beginning at the highest, and so proceede to the lowest.

Of the highest Spheare or Heauen, called the imperiall heauen.

Cap. 5.

THe imperiall heauen (as our auncient Diuines affirme) is immooueable and being created by God the first day that he began the first creation of the world, was by him immediatly replenished with his ministers the holy Angels, and this heauen being the foundation of the world, is most fine and pure in substance, most round of shape, most great in quantitie, most cleare in qualitie, and most high in place, where God and his Angels are said to dwell.

Of the tenth Spheare or heauen, called in Latine, *primum mobile*, that is, the first moueable, and what motion it hath.

Cap. 6.

THis heauen is also of a most pure and cleare substaunce and with out starres, and it continually moueth with an equall gate from East to West, making his reuolution in 24. houres, which kind of mouing is otherwise called the diurnall or daily mouing, & by reason of the swiftnesse therof, it violently carieth and turneth about all the other heauens that are beneath it from East to West, in the selfe same space of 24. hours, whether they will or not, so as they are forced to make their owne proper reuolutions, which is contrary from West to East euery one in longer or shorter time, according as they bee far or neare placed to the same: yet some writers doe not admit any violence in the heauens, but that euery heauen hath his proper and naturall mouing without any violence.

I doe not well vnderstande by what reason the first moueable should haue such force ouer the rest.

For your better vnderstanding how this may be, suppose that you turne with your hand from East to west a Grindstone, or som other turning wheele, whereon is placed a Fly or some other creeping worme which commeth towardes you from West to East, & you shall easily conceiue that by your swift turning of the wheele, you shall turne about the said Fly or worme many times contrary to her own course, whether she wil or not, before she can get about the said stone or wheele.

That is true, proceede therefore to the rest, and tell the nature and mooving of the ninth heauen.

Of the ninth heauen, what motions and names it hath, and whether there be any waters aboue the firmament or not.

Cap. 7.

THe ninth heauen is also cleare of substance, and without starres, hauing two mooings, the one from East to West vpon the poles of the world, according to the daily mooving of the first moueable, and the other from

from West to East vpon his owne poles, according to the succession of the signes of the Zodiaque, which is in the first moueable, turning so slowly about as it maketh but one degrée in 100. yeares, and accomplisheth his full reuolution in 36000. yeares or as Alfonsus saith in 49000. yeares.

Is there then in the first moueable any Zodiaque, that is to say, a broad Circle carrying the 12. signes and yet no starres?

Yea though there bee no starres, yet many superstitious fooles doe imagine that there be diuers Characters and liniaments not to be séene, but with a most sharpe and subtill sight (by vertue of which Characters & fained constellations) they imagine that they can worke wonders and strange effects, inough to deceiue themselues and others too.

What is the cause that the ninth heauen is so long in making his proper reuolution.

Because as I said euen now, this heauen is placed next to the first moueable, which carieth him about contrary to his own course with such violence as he cannot make his owne proper reuolution so soone as the other heauens which are placed further off.

If the ninth heauen be so long in making his course, it will neuer be compleat whilst the world lasteth, for the whole age of the world according to some, is but 6000. yeares?

Yet Plato was of an other opinion, and therefore this reuolution was called, magnus annus Platonis, that is to say, the great yeare of Plato, because hee affirmed that when this reuolution was once complet, all things should be in the same estate wherein they were at the first, and that he should then stand reading to his Schollers in the selfe same chaire wherein he stood at that present, which fond opinion S. Augustine confuteth in his 12. Booke de Ciuitate Dei, speaking in this manner, God forbid (saith he) that we should credit these things, for Christ dyed once for our sinnes, and being risen againe from the dead, he is no more to die, neither can death haue any more power ouer him, by vertue of whose resurrection, we also that beléue shall rise againe, and dwell with God for euer.

With what name is this ninth heauen called?

Some do call it the Christalline heauen, because of the clearenes thereof, and some the watrie heauen, because the Scripture

affirmeth that therebe waters aboue the firmament as wee reade in Gen. cap. 1. let the firmament be made, and diuide the waters from waters. Againe we read in the Psalmes, all ye waters that be aboue the firmament, bleſſe ye the Lord.

The naturall Philoſophers allow no waters to dwell aboue the firmameur.

That is true, yet notwithſtanding if the holy Scriptures doe manifeſtly affirme that there be waters aboue the firmament, it behoueth a Chriſtian to beleeue it, but queſtion perhaps may be moued, what manner of waters they are ẏ are aboue the firmament, whether ſuch as breed raine, or whether they are only to be referred to the Chriſtalline heauen, becauſe it is of a watrie ſubſtance, and therefore of ſome is called the watry heauen, affirming it to be placed nert to the primum mobile, or firſt moueable, to the intent that with the coldneſſe thereof, it might aſſwage & repreſſe the extreame heat of the ſame primū mobile, which otherwiſe (as ſome affirme) with his ſwift & violent mouing, would ſet all the heauens on fire, and yet no raine is bred therein, for the great raine that drowned the world in Noahes time, did not fall from aboue the firmament, but from the Aire, which in the holy Scriptures is many times ſignified by this Latine word Cœlum, that is to ſay, Heauen, as when the Scripture ſaith, the flood gates of heauen were opened, is as much to ſay as the flood-gates of the Aire were opened, &c. but leauing this queſtion, let vs proceede to the eight heauen.

Of the eight heauen what motions it hath, and what circles are imagined by the Aſtronomers to be in that heauen, and to what vſe and purpoſe they ſerue: Alſo in what time euery one of the ſeuen Planets maketh his reuolution, & of what thicknes their Spheares be.

Cap. 8.

THe eight heauen otherwiſe called the firmament, is a moſt glorious heauen adorned with all the fixed ſtarres.

Why are they called fixed?

Becauſe they are faſtned in this heauen, like knots in a knottye board, hauing no mouing of them

themselues, but are moued according to the mouing of this eight Spheare or heauen wherein they are fixed.

How manifold is the mouing of this heauen?

The mouing of this heauen (as hath beene said before) is threefold, for first it turneth about euery day from East to West in 24. houres, according to the mouing of the first moueable, otherwise called the diurnall mouing. Secondly it moueth from West to East, according to the mouing of the ninth heauen, which maketh but one degree in a 100. yeares, and this mouing is called motus augium Stellarum fixarum.

What are Auges?

They be certaine imagined points in the heauen, notifying the furthest distance of any Orbe or Spheare from the Centre of the world: Thirdly it moueth sometime towardes the South, and sometime towards the North, by vertue of his owne proper mouing, called in Latine motus trepidationis, that is to saye, the trembling mouing, whereby it is moued vpon two little Circles, the poles whereof are in the beginning of that Aries and that Libra which are imagined to be in the ninth heauen, the Semidiameter of which little Circles is 4. degrees 1′8. and 4″3. & maketh his whole reuolution in 7000. yeares, and this mouing is otherwise called motus accessus & recessus, that is to say, the mouing of approching and retiring, and is only proper to the 8. Spheare: for euery naturall body by order of nature, can haue but one proper mouing, and by reason of this mouing the fixed starrs bee not alwaies equally distant from the immoueable poles of the tenth Spheare, nor alwaies vnder ỳ Ecliptique of the said 10. Sphere, but oftentimes cleane without it Nor the fixed starrs are in equall times equally distant from the beginning of that Aries & Libra, which are imagined to bee in the tenth heauen, but they seme to moue sometimes towards the East, and sometimes towards the West, now more swiftly, and now more slowly. For Ptolomy in his time found them to be mooued in 100. yeares one degree. And the latter obseruers haue found them when they bee in their swift motion to be mooued one degree in 63. yeares, al which three mouings are easie (as some affirme) to be demonstrated by an instrument made of purpose, shewing euery seueral mooving of this heauen by it selfe, but such demonstrations as some others thinke bee

not

not altogether necessary conclusions: for it may be that the dayly moouing is common to the whole frame, and that the moouing of the Auges of the fixed starres, is proper to the eight Spheare, hauing some other moouer, and the like obiection may bee made touching the trembling moouing, called motus trepidationis. But now you haue to vnderstande that for the better describing, deuiding, and measuring of this heauen, and all the apparances thereof, the Astronomers with the Pensill of imagination, or rather of most necessarie inuention, doe (as it were) trace the same with certaine Circles both greater and lesser, whereof wee shall speake as soone as we haue briefely shewed the mouing of the rest of the heauens, contained in the celestiall part of the world, in such order as they follow one another. For next to the firmament is the heauen of Saturne, which maketh his reuolution from West to East in 30. yeares, next to him is the heauen of Iupiter, who maketh his reuolution from West to East in 12. yeares, next to him is the heauen of Mars, which maketh his reuolution also from West to East in 2. yéres, next to him is the heauen of the Sunne, which maketh his reuolution from West to East in 365. dayes, and 6. houres lacking certaine minutes, next to him is the heauen of Venus, which maketh her reuolution from West to East in like time as doth the Sunne, next to Venus is the heauen of Mercury, which maketh his reuolution from West to East in the like space that Venus doth: And next to Mercury is the heauen of the Moone, which maketh her reuolution from West to East in 28. daies and certaine minutes. Thus hauing briefely described the eleauen heauens, I will now treat of the Circles that are imagined (as I said before) by the Astronomers to be in the eight heauen or firmament, to the intent that the measures and distances of the starres, images, signes, and other apparances therein contained, might be the better demonstrated.

Before you deale with these Circles, I would gladly vnderstand some reason why all these seuerall heauens seeme to the eye but as one entire body.

That is because they are all cleare and transparent like fine birall glasse, or Christall, through the which the sight doth easily pearce, though there were neuer so many coates of such cleare substance, couering one another like the skales of an Onion, for so

so the heauens doe couer and enclose one another, and euery one is of an exceeding great thicknesse.

Why how thicke is euery such heauen?

The heauen of the Moone ——— 105/222. $\frac{3}{33}$ miles.
containeth in thicknesse.
The heauen of Mercury containeth ——— 25337$\frac{3}{5}$
The heauen of Venus ——— 3274494 $\frac{6}{11}$
The heauen of Sol, ——— 343996 $\frac{4}{11}$
The heauen of Mars, ——— 26/308/300.
The heauen of Iupiter, ——— 1899654 $\frac{6}{11}$
The heauen of Saturne, ——— 19604454 $\frac{6}{11}$

What neede haue the heauens to be so thicke?

Because otherwise they coulde not containe eth one his starre or starres, for there is no fired starre so little, but that it is farre greater in compasse then the earth, neither is there any wandring starre, but that it is bigger then the earth, the Moone, Venus and Mercury excepted.

For the Sunne containeth the earth ——— 166. times.
Saturne containeth it ——— 95. times.
Iupiter containeth it ——— 91. times.
Mars containeth it ——— 2. times.
Venus is lesser then the earth ——— 39. times.
Mercury is least of all and is contained of the earth, ——— 3143. times

You haue well satisfied mee touching these matters, and therefore nowe proceede with the Circles if you thinke so good.

Before that I describe vnto you the Circles whereof a Sphere is made, or declare the vses thereof: I thinke it not amisse here to set downe the shape of a Spheare, together with the names of euery Circle written vpon the same, to the intent that you may be acquainted with all the partes of a Spheare before you come to vse the same: which shape or figure was first drawne by Master Blagraue, and is set downe in his booke called the Mathematicall Iewell.



Of the Circles whereof a materiall Spheare consisteth, and of their diuers diuisions.

Cap. 9.

OF Circles which are imagined to be in the firmament, and whereof a Spheare representing the shape of the world is commonly made, be in all 10 that is to say, the Equinoctiall, the Zodiaque, the two Colures, the Horizon, the Meridian, the two Tropiques and the two polar Circles of which Circles some be greater and some lesser.

Which

Which call you greater and which lesser?

Those are called the greater Circles, which passing through the Centre or midst of the firmament, doe deuide the whole circuit thereof into two equall partes, and of such Circles there bee sixe, that is to say, the Equinoctiall, the Zodiaque, the Colure of the Solstices, the Colure of the Equinoxes, the Horizon and the Meridian. The lesser Circles are the foure last mentioned, that is the two Tropiques, and the two polar Circles, which are called lesser, because they doe not deuide the world into two equall partes, but into vnequall portions.

What other diuisions doe the Astronomers make of the said Circles?

Diuerse, for some are said to be paralels, some right, some oblique, some moueable, and some immoueable.

Which are said to be paralels?

The two polar Circles, and the two Tropiques, and the Equinoctiall which is in the very midst of them all.

Which are said to be right and which oblique?

The right be the two Colures, the right Horizon, & the Meridian, because they cut the Spheare or Globe with right Angles: And the oblique are these two, that is, the Zodiaque, and the oblique Horizon, which are saide to bee oblique because they cut the Spheare or globe with oblique Angles.

Which are said to be moueable, and which immoueable?

The moueable are these, the Equinoctiall the Zodiaque, the two Tropiques, & the 2. polar Circles which are said to be moueable, because they continually moue with the firmament & are like in all places. And these also hauing respect to a material Sphere, are said to be intrinsicall or inward. The immoueable are these 2, that is, the Horizon, & the Meridian, which are said to be immoueable because in the turning of the Spheare they remaine vnmooued, for though wee change both Meridian and Horizon by going from one habitation to another vpon the earth, yet euery place hath still his owne Meridian and Horizon, which doe remain immoueable, and these two Circles hauing respect to a materiall Spheare, are said to be extrinsicall or outward, because they do inclose on the outside all the other Circles of a materiall Spheare. Thus hauing sette downe the diuisions of the sayde Cycles,

I will

I will now describe them all in order, and shew to what vses they serue, beginning first with the great Circles, and so proceede to the lesser, and first I will speake of the Equinoctiall.

Of the Equinoctiall line, why it is so called, and of the diuers vses thereof.

Cap. 10.

WHat is the Equinoctiall?

The Equinoctiall is a great Circle, which being in euerie part equally distant from the two poles of the world, deuideth the Spheare in the verie midst thereof, into two equall parts, and therefore it is called of some, the girdle of the world.

Wherefore is it called by the name of the Equinoctiall?

Because that when the Sunne toucheth this Circle, which is twice in the yeare, the day and night is of equall length throughout the world.

At what time of the yeare is it Equinox?

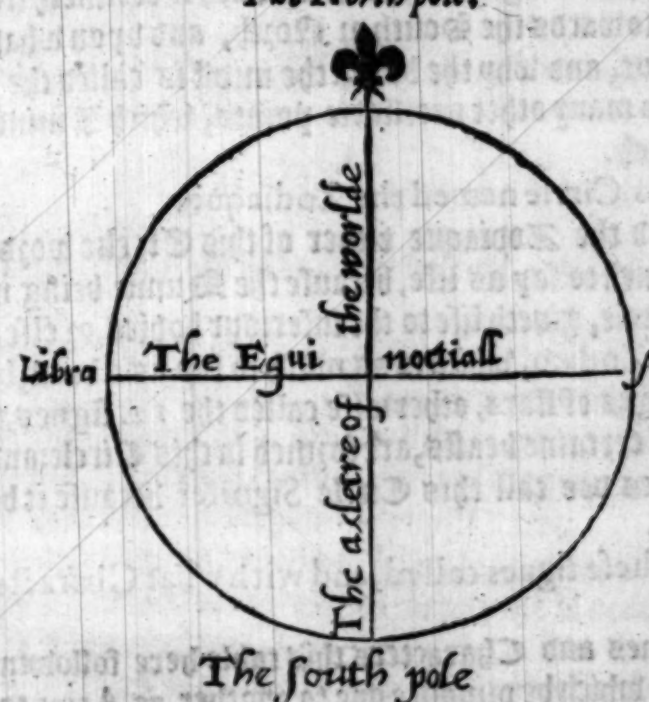
In the spring of the yeare, about the 11. day of March when as the Sunne entereth into the first degree of Aries, and againe in Autumne about the 13. of September when as the Sunne entereth into the first degree of Libra, And by reason that this Circle deuideth the world in the verie midst, those that dwell right vnder it, are said to haue no Latitude either Northward or Southward, to whom the dayes and nights are alwayes equall. But if they dwell any thing distant from the Equinoctiall, towardes any of the poles, then they are said to haue Latitude more or lesse, eyther Southward or Northward, as shall bee declared hereafter more at large, when wee come to treate of the Longitude and Latitude of the earth, both which are to bee knowne by helpe of the Equinoctiall.

To what other vses serueth this Circle?

This Circle hath many most necessarie vses, for first it sheweth the daily moouing of the first moueable, which maketh his reuolution

lution in 24. houres, which houres are equall, and are to be measured by the degrées of the Equinoctiall, by allowing 15. degrées thereof to an houre. And therefore the degrées of the Equinoctiall are commonly called in Latine of the Astronomers tempora, of which degrées it containeth 360. which being diuided by 15. doe make 24. houres, which is a naturall day, containing both day & night: Moreouer it sheweth the declination of the fixed starres and their right ascentions, whereof wee shall speake when we come to treate of the starres, and by his equall motion, all the inequalities of the Zodiaque, and of all the signes contained therein, are measured: And to be short, this Circle hath many other good vses not to be declared vntill you haue some knowledge of the rest of the other Circles hereafter described.

A figure shewing the Equinoctiall line, the two Poles and Axletree of the world.



Of the Zodiaque why it is so called, and of the 12. signes therein contained: Also of the Latitude, Longitude, and declination thereof.

Chap.

Cap. 11.

WHat is the Zodiaque?

It is a broad, oblique, or slope Circle, hauing a circular line in the midst thereof, called the Ecliptique line, and deuideth the Spheare into two equall partes, by crossing the Equinoctiall with oblique Angles in two points, that is in the beginning of Aries, and in the beginning of Libra, so as the one halfe of this broad Circle declineth towardes the North, and the other halfe towardes the South: in which Circle many thinges are to bee considered, first the name, then what breadth it hath, and why it hath such breadth, and into what parts it is deuided aswell touching the breadth or Latitude, as circuit or Longitude thereof, also into how many parts the firmament is deuided by the spaces described in the Zodiaque, and appointed to the 12. signes. Also how much it declineth from the Equinoctiall towards the South or North, and vpon what poles it turneth about, and why the line in the midst is called the Ecliptique line, and many other necessarie points, which I minde here briefely to touch.

Why is this Circle named the Zodiaque?

It is named the Zodiaque either of this Greeke worde zoe, which is as much to say as life, because the Sunne being moued vnder this Circle, giueth life to the inferiour bodies, or else of this Greeke word Zodion, which is as much to say as a beast, because that 12. Images of starres, otherwise called the 12. signes, named by the name of certaine beastes, are formed in this Circle: and therfore the Latines doe call this Circle Signifer because it beareth the 12. signes.

How are these signes called, and with what Characters are they marked.

Their names and Characters this table here following doth shew, and also which be opposite one to another, as Aries to Libra Taurus to Scorpio, and so forth.

The fixe Northerne signes.		The fixe Southerne signes.	
Aries	♈	Libra	♎
Taurus	♉	Scorpio	♏
Gemini	♊	Sagittarius	♐
Cancer	♋	Capricornus	♑
Leo	♌	Aquarius	♒
Virgo	♍	Pisces	♓

Of which signes the first fixe on ỹ left hand are called the Northerne signes, because they are contained in that halfe of the Zodiaque, which declineth towards the North. And the other fixe on the right hand being right opposite to the first 6. are called the Southerne signes, because they are contained in the other halfe of the Zodiaque, declining towards the South: And against euerie signe is set his proper Character.

What diuisions doe Astronomers make of the 12. signes.

Diuerse, as followeth: for some are said to be ascendent, and some descendent.

Ascendent are those that rise from the South towards our Zenith, tending Northward, which be these, Capricornus, Aquarius, Pisces, Aries, Taurus, and Gemini.

The descendent are these, Cancer, Leo, Virgo, Libra, Scorpio and Sagitarius.

Againe some are saide to bee vernall, as Aries, Taurus, and Gemini.

Some Estiuall as Cancer, Leo, Virgo.

Some Autumnall as Libra, Scorpio, and Sagitarius.

And some Hiemall or Brumall, as Capricornus, Aquarius, and Pisces, signifying the foure seasons of the yeare, that is to say, the Spring, Sommer, Autumne, and Winter.

And some doe make diuerse other diuisions, which because they appertaine to Astrologie rather then to the Treatise of a Spheare I willingly omit them.

Now tell what breadth the Zodiaque hath, and why it is imagined to haue such breadth?

It hath (according to the ancient writers) 12. degrées in breadth, that is to say, 6 degrées on the one side of the Ecliptique line, & 6. degrées on the other side of the Ecliptique line, but according to

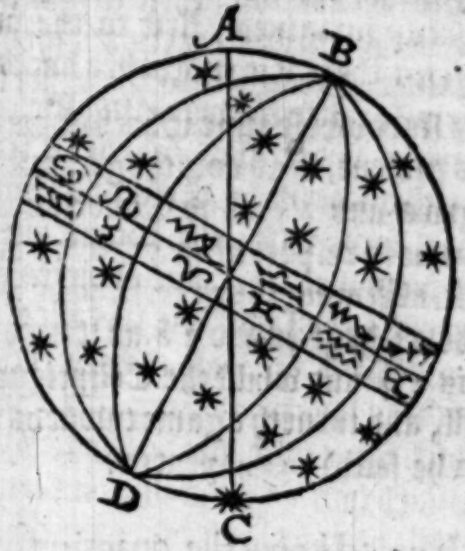
the moderne writers, it hath 16. degrées in breadth, that is, eight degrées on ech side of the Ecliptique line, which breadth was necessarily imagined, first to the intent that by the measures and degrées thereof it might bee knowne, how much the Planets (otherwise called the wandring starres, whose course is to passe continually vnder this broade Circle) doe wander at any time on either side of the Ecliptique line, for they all wander, but some more, some lesse, the Sunne onely excepted, which neuer swarued from that line, but alwayes goeth right vnder the same, and therefore the saide line is called of some writers the way of the Sunne: And secondly it hath such breadth to the intent it maye containe within the same, the 12. signes aforesaid, by meanes of which signes the whole circuit or longitude of the saide Circle is deuided into 12. equall parts, and euery such part is deuided into 30. degrées, and euery degrée into 60. minutes, and euery minute into 60. seconds, &c. so as the whole Longitude thereof containeth 360. degrées, according vnto which diuision, all the rest of the Circles both greater and lesser described in the Spheare, are made to containe the like number of degrées, and euerye halfe Circle to containe 180. degrées, and euery quarter of a Circle to containe 90. degrées, and by this diuision as well of the breadth as of the length of the Zodiaque, it appeareth that euery one of the 12. Signes hath 30. degrées in length, and 12. degrées in breadth, and therefore the Planets, Starres, and all other Celestiall bodies are said to haue both Longitude and Latitude, the Sunne onely excepted.

How is such Longitude and Latitude to be vnderstood?

The Longitude of any Planet or Starre is to bee counted in the Ecliptique line containing in circuit 360. degrées, reckoning from the first point of Aries, and so to Taurus, Gemini, and Cancer, & so forth according to the succession of the signe, vntill you come againe vnto the first point of Aries, at which point such Longitude both endeth and beginneth. The Latitude is counted from the said Ecliptique line towards any of ỳ Poles of the Zodiaque. And hereof loke how many degrées any fixed starre or Planet is distant from the Ecliptique line towards any of the said poles, so much Latitude it is said to haue either Northerne or Southerne: moreouer, by this diuision of the signes the whole firmament is

deuided

deuided into 12. parts by reason of 6. Circles called the circles of position, imagined to passe through the poles of the Zodiaque, and also through ỳ beginning of euery signe, wher by we know vnder what signe euery star is situated though it be cleane out of the Zodiaque as this figure here plainely sheweth, marked with these letters A.B.C.D. A signifieth the North pole of the worlde, B. the North pole of the Zodiaque, C. the South pole of ỳ world, D. the South pole of the Zodiaque.



How much the Zodiaque declineth from the Equinoctiall towards either of the Poles, and of the greatest declination of the Sunne, what it is at this present, and what it hath beene in times past.

Cap. 12.

YOu haue to vnderstande that the Zodiaque or rather the Ecliptique line, declineth from the Equinoctiall towardes eyther of the poles, 23. degrées 2′8. and that is saide in these dayes to be the greatest declination of the Sunne, which declination is twofold, that is Northerne and Southerne, for like as the Sunne entring into the first pointe of Aries, beginneth then to decline from the Equinoctiall Northward, to the quantitie of 23. degrées and 2′8. so entring into the first point of Libra, he declineth againe from the Equinoctiall as much Southward. And note by the way that by reason of this slowe motion, when he is in the Northerne signes, he spendeth 7. dayes, and $\frac{1}{7}$ of a daye more in making his North declination then in making his South

declination, because hee is then in his swift motion, and the time hath béene that he hath spent aboue ten dayes more in making his North declination, then in making his South declination: neither is the greatest declination of the Sunne in all ages of like quantitie. For in Ptolomies time it was 23. degrées, 51. and 20 euer since whose time it hath alwaies continually decreased vntill this present, so as now the greatest declination is no more but 23 degrées and 28. And Copernicus maketh the declination of the Sunne in respect of quantitie to bee twofold, that is greatest and least, affirming the greatest to be 23. degrées and 52. and the least to be 23. degrées and 28. as it is now counted, the difference whereof is 24. and whilst the Ecliptique departeth from the Equinoctiall, and turneth againe towards the Equinoctiall, there doe run (as he saith) 3434. yeares.

How to know the quantitie of the Sunnes declination bee it Northward or Southward, euery day throughout the yeare, as well by a Table as by helpe of the Spheare.

Cap. 13.

THis is chiefely to bee knowne by Tables calculated of purpose, which Tables most commonly are eyther made to aunswere euerie day of the moneth, or else to the degrée of the signe wherein the sunne is euery day, which kinde of Table is contained in lesser roome then the other, but to worke by such a Table, you must first knowe in what signe and degrée the sunne is euery day.

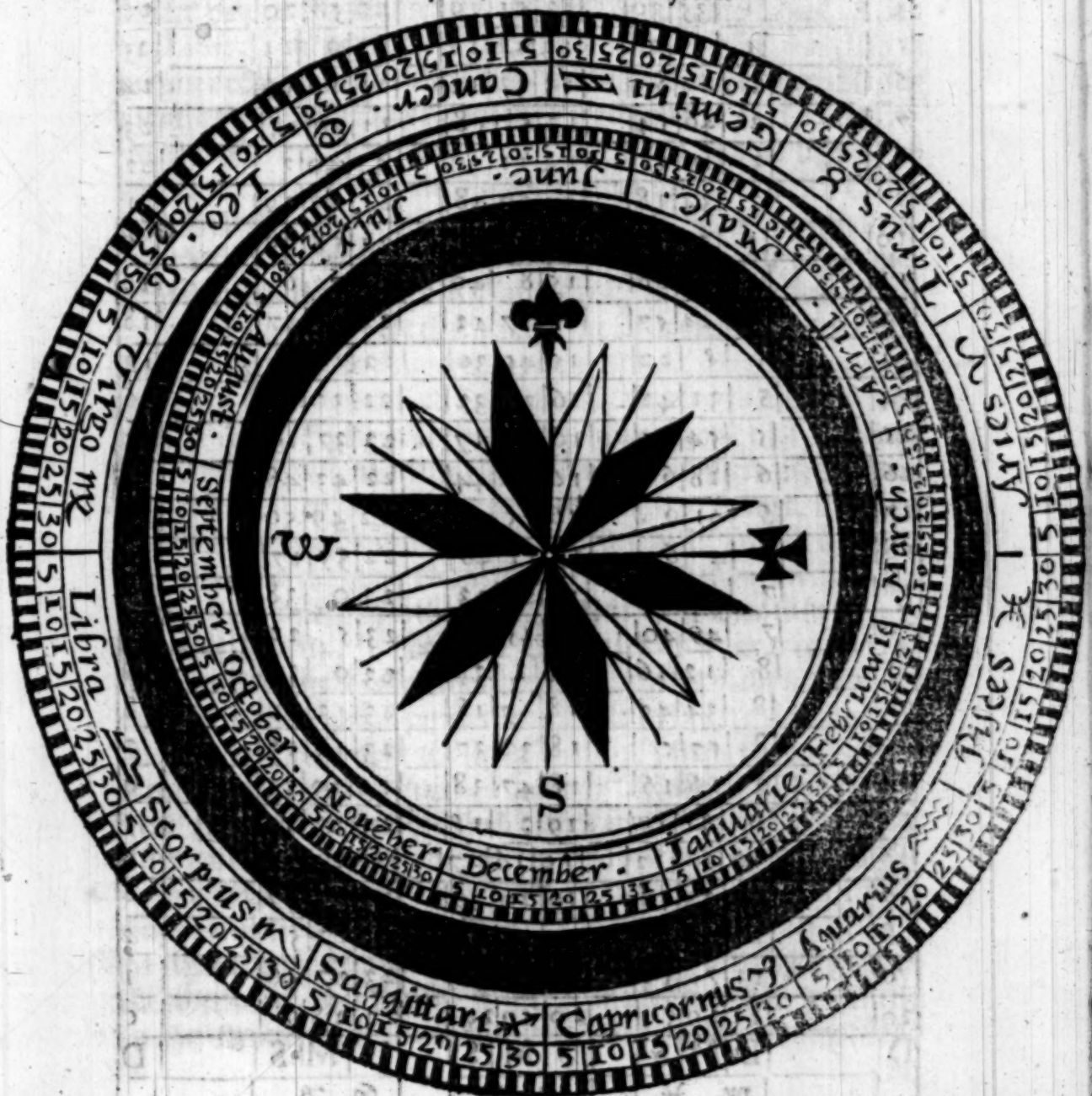
How is that to be done?

It is to bee knowne most truely by the Ephemerides or such like Table calculated of purpose, shewing not onely the degrée of the signe, but also the verie minute wherein the Sunne is euerie day, and for want of such a Table, you may without consideration of the minutes, know it by such an instrument or figure as this following, which consisteth of diuerse Circles, whereof the outermost contayneth the degrées of the 12. signes, together with

the

the names of the said signes, and the next the daies of ech moneth, together with the name of the said moneths, much like the backside of an Astrolabe, in the center or midst of whic instrument or figure is a thred, which if you lay vpon the day of the month which you seek it will straight direct you to the degree of the signe wherein the Sun is that day, as for ex ample, if you would know in what signe and degree the Sun is the 4. of May, then by drawing the thred right vpon the said day ouer and beyond the outermost circle, you shall find that it will fall right vpon the 23. degree of Taurus.

An instrument to know thereby in what signe and degree the Sunne is euery day throughout the yeare.



Then hauing found the degree of the Sun you must resort therewith to this Table following, made for the declination of the sun.

A Table shewing the declination of the sun euery day throughout the yeare

Degrees of the Signes	♈ ♎ D	M	S	♉ ♍ D	M	S	♊ ♐ D	M	S	Degrees of the Signes
1	0	23	53	11	50	6	20	22	57	29
2	0	47	46	12	10	56	20	35	7	28
3	1	11	39	12	31	34	20	46	55	27
4	1	35	30	12	51	59	20	58	20	26
5	1	59	20	13	12	12	21	9	21	25
6	2	23	8	13	32	12	21	19	59	24
7	2	46	54	13	51	58	21	30	13	23
8	3	10	37	14	11	30	21	40	2	22
9	3	34	18	14	30	48	21	49	29	21
10	3	57	54	14	49	51	21	58	29	20
11	4	21	28	15	8	40	22	7	6	19
12	4	44	57	15	27	13	22	15	17	18
13	5	8	22	15	45	30	22	23	3	17
14	5	31	42	16	3	32	22	30	24	16
15	5	54	57	16	21	17	22	37	19	15
16	6	18	6	16	38	44	22	43	48	14
17	6	41	9	16	55	55	22	49	50	13
18	7	4	6	17	12	48	22	55	27	12
19	7	26	57	17	29	23	23	0	38	11
20	7	49	40	17	45	40	23	5	22	10
21	8	12	16	18	1	39	23	9	39	9
22	8	34	45	18	17	18	23	13	29	8
23	8	57	5	18	32	37	23	16	53	7
24	9	16	16	18	47	38	23	19	50	6
25	9	41	19	19	2	18	23	22	19	5
26	10	3	12	19	16	37	23	24	22	4
27	10	24	56	19	30	36	23	25	57	3
28	10	46	30	19	44	14	23	27	5	2
29	11	7	53	19	57	30	23	27	46	1
30	11	29	5	20	10	25	23	28	9	0
D	D	M	S	D	M	S	D	M	S	D
	♍	♓		♌	♒		♋	♑		

The description and vse of the Table.

This Table consisteth of fiue collums, whereof the first on the left hand, and the last on the right hand doe containe the degrees of the 12. signes of the Zodiaque, counting from one to 30. And the three middle collums doe containe the degrees minutes, and seconds of declination, ouer the head of which three middle collums are set downe the Characters of these 6. opposite signes, Aries and Libra, Taurus and Scorpio, Gemini and Sagittarius, and at the foote of the said middle colums are set downe the characters of the other 6. oppolit signes, that is, Virgo and Pisces, Leo and Aquarius, Cancer and Capricornus, for euery 2. oppolit signes, as well aboue as beneath, haue like declination, the vse of which Table is thus: first hauing found out the degree of the Sun by the instrument before described, or rather by some true Ephemerides, you must seeke out the number of ỳ said degree, either in the first or last collum, according as the character of the signe is placed. For if ſ the signe or character be aboue, then you must seek for the said number in the first collumon the left hand, which numbers do discend from 1. to 30. but if the signe bee beneath, then you must find it out in the outermost collum on the right hand, the numbers whereof doe ascend from 1. to 30. and the common Angle or square, standing right against the saide number will shew you the degree, minutes and seconds of the declination, as for example, hauing found by the former instrument that the 4. day of May the Sunne is in the 23. degree of Taurus, I seeing the Character of Taurus to stand aboue, do seeke my foresaid number of 23. degrees in the first collum on the left hand, and in the common angle or square right against that number, and vnder the signe Taurus, I finde the declination of the Sun to be 18. degrees 32′. and 37″. But this Table cannot serue alwaies: yea rather such tables are to bee renewed as our Astronomers say euery 30. yeares. Also you may know the dayly declination of the Sun, by helpe of the materiall Spheare or globe: thus hauing set the Spheare at your Latitude, bring the degree of the signe wherein the Sunne is that present day vnto the moueable Meridian, and staying it there, marke whether it falleth on the South side or on the North side of the Equinoctiall:

for if it be in any of the Northern signes, it will fall on the North side of the Equinoctial, and if it be in any of the Southern signes, it will fall on the south side of the Equinoctiall, and by counting the degrees vppon the Meridian, contained betwixt the degree of the Sun and the Equinoctiall, you shall know what declination the Sun hath that day, as for example in the latitude 52. in the yeare 1590. the fift day of May, I find the Sunne by the Ephemerides to be in the 23. degree and 48′. of Taurus, which point I bring to the moouable Meridian, and there staying it, I find that point to be distant from the Equinoctial Northward 18. degrees and certaine minutes, and so much of North declination I conclude the Sun to haue that day.

Vpon what Poles the Zodiaque turneth about, also of the Ecliptique line and of the diuers vses thereof. Cap. 14.

The Zodiaque turneth about vpon his owne proper Poles from West to East, whereof the one being placed in the Colure of the Solstices towards the North, is distant from the pole Arctique 23. degrees, & 28′. and the other is placed in the saide Colure towards the South, being of like distance from the pole Antarctique, whereof the Astronomers haue a generall rule, affirming that the distance of the two Poles of the world from the Poles of the Zodiaque, is alwaies equall to the greatest declination of the Sunne, which as hath beene said before, is 23. degrees and 28′. as you may plainly see by the Spheare. And note that these 2. Poles are otherwise called the Poles of the Ecliptique, for in considering the declination of the Sunne or of the Zodiaque from the Equinoctiall, you must haue respect onely to the Ecliptique line, which is in the midst of the Zodiaque, and not to any other parte of the Zodiaque. And as the Equinoctiall line sheweth the mouing of the first moueable, which is from East to West, so the Ecliptique line sheweth the mouing of the seconde moueable, which is from West to East, cleane contrary to the first moueable, the causes whereof haue beene before declared.

What other vses hath this line more than you haue already declared.

It hath diuers, for in this line or Circle are noted the degrées, wherewith any starre riseth or goeth downe, either rightly or obliquely, for all the apparances of the heauens are chiefly referred to this Circle. Againe by this circle the chiefest distinctions and parts of times, as yeares and moneths are knowne, and also the foure seasons of the yeare, as Spring, Summer, Autumne, and Winter: Moreouer, the obliquitie of this circle vnder which the Sunne continually walketh, is cause that the dayes both naturall and artificiall are vnequall. Finally, this circle doth shew the places and times of the Eclipses both Solar and Lunar, from whence this line taketh his name, of which Eclipses we mind here briefely to treate.

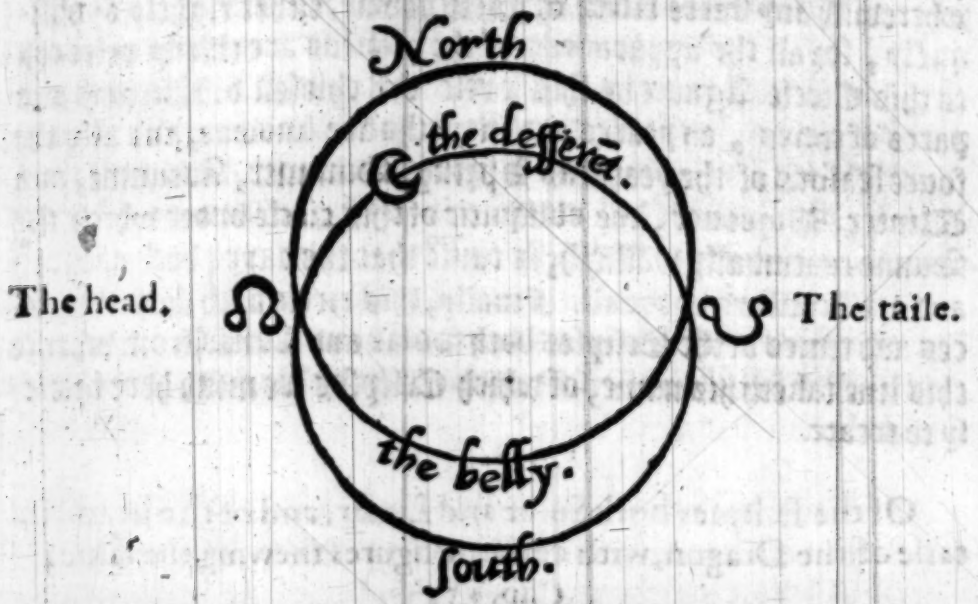
Of the Eclipses both Solar and Lunar, and of the head and taile of the Dragon, with certaine figures shewing the same. Cap. 15.

WHat signifieth this word Eclipsis?

It is as much to say, as to want light, & to be darkened or hidden from our sight, as when the Sun & Moone are both at one selfe time right vnder the Ecliptique line, the one of these two lights most commonly is Eclipsed and darkned: for there bee two Eclipses, the one of the Sunne, and the other of the Moone, but sith that neither the Eclipse of the Sun or of the Moone doth chance, but when they méete either in the head or taile of the Dragon, I thinke it good to shew first what is ment by the head and tayle of the Dragon. The Dragon then signifieth none other thing but the intersection of 2. circles, that is to say, of the Ecliptique, & of the Circle that carieth the Moone, called her Deffferent, cutting one another in 2. poinctes, whereof that intersection which is Westward when as the Moone goeth towards the North, is called the head, and that which is Eastwards when the Moone goeth towards the South is called the taile, marked with such Characters as you sée in the figure following, and that parte towards the South is called of some the belly of the Dragon. And note that the Deffferent of the Moone is at no time distant from the Ecliptique aboue 5. degrées at the most.

The

The figure of the Dragon.



This being presupposed, I will speake first of the Eclipse of the Moone, and then of the Sunne, both which may be Eclipsed either totally or in part.

When is the Moone said to be totally eclipsed?

When the Sunne and Moone are opposite one to the other diametrally, and the earth in the verie midst betweene them both, for the body of the earth being thicke and not transparent, casting his shadow to that point which is opposite to the place of the Sunne, will not suffer the Moone to receiue any light from the Sun, from whome she alwaies borroweth her light.

At what time is the Moone said to be diametrally opposite to the Sunne?

When a right line drawne from the center of the Sunne to the center of the Moone, passeth through the center of the earth: & note that euery time that she is at the ful, she is opposite to the Sun, and yet the earth is not at euery such full diametrally betwixt her and the Sun, for then she should be eclipsed at euery full, which indæde cannot be but when she is either in the head or taile of the Dragon.

When is the Moone said to be eclipsed in part?

When the Sunne, the earth, and the Moone be met in one selfe Diametrall line, but the Moone is declining either on the one side or on the other, as you may plainely see by this figure following

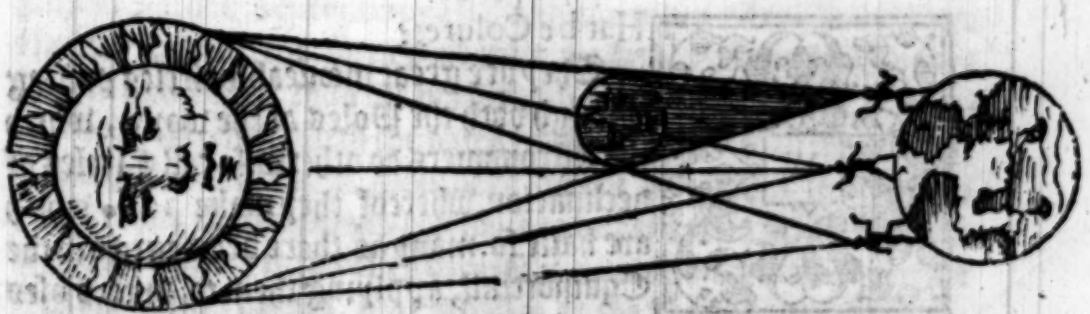
But



But note that the Eclipſes of the Moone may be vniuerſal, becauſe the Earth is farre bigger then the Moone, and thereby able to ſhadow her whole bodie.

When is the Sunne ſaide to be eclipſed?

When the Moone is betwixt the Sunne and the Earth, which chanceth in a Coniunction, and yet not in euery coniunction, but when it falleth either in the head or taile of the Dragon, which may chance, as I ſaide before, either totally or in part: totallie I ſay, in reſpect of thoſe parts of the earth whereon the ſhadow directly falleth. For ſith the Moone is farre leſſer than the Earth, ſhee cannot ſhadow all the Earth, and therefore the Eclipſe of the Sunne cannot be vniuerſall, but yet to ſome parts of the Earth totally, and to ſome partly, and to other ſome nothing at all, as you may plainly ſée by this figure following.



Yet all the hiſtories doe affirme that the Eclipſe of the Sun was vniuerſall at the death of Chriſt.

Yea, that was miraculous, and alſo it was then at the full of the Moone, which was alſo as miraculous: and therefore Dioniſius a Senator of Athens, beholding that Eclips cryed out, ſaying

ing these words, Either God this day suffereth or else the world must needes perish for euer: which Dionisius was the first that conuerted the Frenchmen to the faith of Christ, doing there great miracles, in honour of whome was erected the rich Abbey of S. Denise, not farre from Paris, whereas the Kings and Princes of France were wont to be buried.

How is it to be prooued that the Eclipse at Christ his death was at the full of the Moone?

As well by ancient history, as by S. Augustine, who saith that the Iewes were wont to kéepe their feast of Passouer (at which time Christ suffered) alway at the full of the Moone.

If the Sun and Moone be eclipsed but in part, how are such partes to be accounted?

By the parts of the Diameter of the bodies of those two Planets, for the Astronomers doe diuide the Diameter as well of the Sunne, as of the Moone into 12. and some into 24. parts, which they call points, and therefore are wont to say, that the Sunne or Moone are darkned or eclipsed 7. points, 8. points, 9. points, &c.

Of the two Colures, and why they are so named, and whereto they serue: also of the foure Cardinall points, that is, of the two Equinoctiall, and the two Solstitiall points, and of the entrance of the Sunne into any of those points or into any other signe.

Cap. 16.

WHat be Colures?

They bee great moueable circles passing through both the Poles of the world, which the Astronomers do otherwise call Circles of declination, whereof they make 180. which are halfe so many as there bee degrées in the Equinoctiall, applying them to diuers vses not néedfull here to be rehearsed, for sith that there are but 2. Colures accustomably set downe in the Spheare, without the which a materiall Spheare cannot be made, I minde héere therefore onely to treate of them.

Shew first what this name Colure signifieth.

This word Colure béing compounded of Colos and Oura,

is

is as much to say as vnperfect or maymed, the tatle being cut off, because none of these Circles are euer séene whole aboue our Horizon, but parte thereof, for some part is alwayes seene, and some part is alwaies hidden, as that part which is aboue the Horizon, and nigh vnto the Pole, is alwaies seene, because it neuer goeth downe vnder the Horizon: likewise that which is nigh vnto the South pole is alwaies hidden from vs, because it neuer riseth aboue our Horizon, as by turning the Spheare about, you may easilie perceiue the same.

Which be those Colures that are commonly set downe in the Spheare, and how are they named?

They are two great moueable circles, passing through the Poles of the world, crossing one another in the said Poles with right Sphearicall angles, by meanes whereof they deuide the whole Spheare into foure equall partes, of which two Colures the one is called the Colure of the Equinoxes, and the other the Colure of Solstices.

Describe these two Circles, & shew why they are so named?

The Colure of the Equinoxes is so called because it cutteth the Zodiaque in the beginning of Aries, which is called the vernal Equinoxe: and also in the beginning of Libra, which is called the Autumnall Equinoxe, at which two times the daies and nightes be equall, as hath beene said before when we did speake of the Equinoctiall circle, and this circle deuideth the Ecliptique into two halfes, the one Septentrionall, and the other Meridionall and thereby sheweth the signes wherein the Sunne maketh the dayes longer and shorter than the nights, for whilest he is in the 6. Northern signes, he maketh the daies with vs longer then the nights, and when he is in the 6. Southern signes he maketh the nightes longer then the daies: now you haue to vnderstand that the Colure of the Solstice, is so called because it cutteth the Zodiaque in the two Solstitiall points, that is to say, in the beginning of Cancer, and the beginning of Capricorne, as you may sée in beholding and turning the Spheare about with your hand.

Why are these two points called Solstitiall?

They take their name of these two Latine words Sol and statio, that is to say, the Sun and standing, for when the Sunne is in any of the two points, hee séemeth to stand still, or at the least

mo-

moueth so little, as his proper moouing from West to East cannot be easily perceiued, during the space of twelue dayes. And you haue to note, that when the Sunne entereth into the first degrée of Cancer, which is about the 12. of June, then hée is at the highest, and the dayes be at the longest, and therefore, it is called the Summer Solstice. Againe, when hee entereth into the first degrée of Capricorne, which is about the 12. of December, then the Sunne is at the lowest, and the nights are at the longest, & therefore it is called the Winter Solstice. And in this Colure there are set downe the two Poles of the Ecliptique line being distant from the Poles of the world 23. degrées and 28. Moreouer on this Colure is measured the greatest declination of ꝑ Sun, which is alwayes equall to the distaunce of the Pole of the Ecliptique, from the Pole of the world, as hath béene said before. And you haue to note that the 4. former points, that is to say, the 2. Equinoxes, and the 2. Solstices, are commonly called the foure cardinall or principall pointes, and of some they are called, the foure pointes of Change, signifying the 4. beginnings of the foure diuers seasons of the yeare: for betwixt the beginning of Aries and beginning of Cancer, is contained the Spring time, and betwixt the beginning of Cancer and the beginning of Libra, is the Summer time: and from the beginning of Libra to the beginning of Capricorne is the time called Autumne, or fall of the leafe: and from the beginning of Capricorne to the beginning of Aries is contayned the winter season, albeit the Sunne entreth not into any of these signes alwayes at one selfe day or time of the yeare, for at Christ his incarnation, the Sunne entred into Aries the 25. of March, and into Cancer the 24. of June, and into Libra the 27. of September, and into Capricorne the 25. of December, which was then the shortest day in the yére, and the beginning of Winter, and therefore is called of the Latines, dies brumalis, on which day Christ our Sauiour was borne, so as from the time of his birth vnto this present yeare, there are runne almost 13. dayes, wherefore, vnlesse the Kalenders bee reformed as well heere in England as elsewhere (for the Romane reformation is not so exactly true as it might bee) wee shall haue in processe of time, the Spring in Winter, and the Winter in Autumne.

How

How shall I know this present yeare, or any yeare to come hereafter, at what day and houre the Sunne entereth into any of the 12. Signes?

First you must learne by some good Ephemerides, or other Table, the true entrance of the Sun into euery signe in any yeare passed before, then from the time of the entrance of the Sunne into the signe which you desire to know, consider how many yeares are betwixt, and how many leape yeares are in the same contained, and substract for so many times as there be leape yeares, 4′4, of an houre, and ad to the houres remaining, so many times fiue houres, and 4′9. as there bee yeares remaining ouer and besides the leape yeares, and that summe shall shew you the day, houre, & minutes of the true entrance of the Sunne into that signe in the same yeare that you desire to know.

Of the Horizon both right and oblique, making thereby three kinds of Spheares, that is, the right, the Paralell, and the oblique Spheare.

Cap. 17.

WHat is the Horizon?

It is a great immoueable circle which deuideth the vpper Hemispheare, which is as much to say, as the vpper halfe of the world which we see, from the nether Hemispheare which wee see not, for standing in a plaine field, or rather vpon some high mountaine void of bushes and trées, and looking round about, you shall see your selfe inuironed as it were with a circle, and to be in the very midst or centre thereof, beneath or beyond which circle, your sight cannot passe, and therfore this circle in Greéke is called *Horizon*, and in Latine *Finitor*, that is to say, that which determineth, limitteth or boundeth the sight, the Poles of which circle are imagined to be two points in the firmament, whereof the one standeth right ouer your heade, called in Arabick Zenith: and the other directlie vnder your féete, called in the same tongue Nadir, that is to say the pointe opposite, and from point to point you must imagine that there goeth a right line passing through the centre of the worlde, and also through

through your bodie both head and feet, which is called the Arletres of the Horizon, and you haue to vnderstand that of Horizons there be 2. kinds, that is, right & oblique, making 3. kinds of Spheares, that is to say, the right Spheare, the paralel Spheare, and the obliqne Spheare.

When is the Horizon said to be right, and thereby to make a right Spheare?

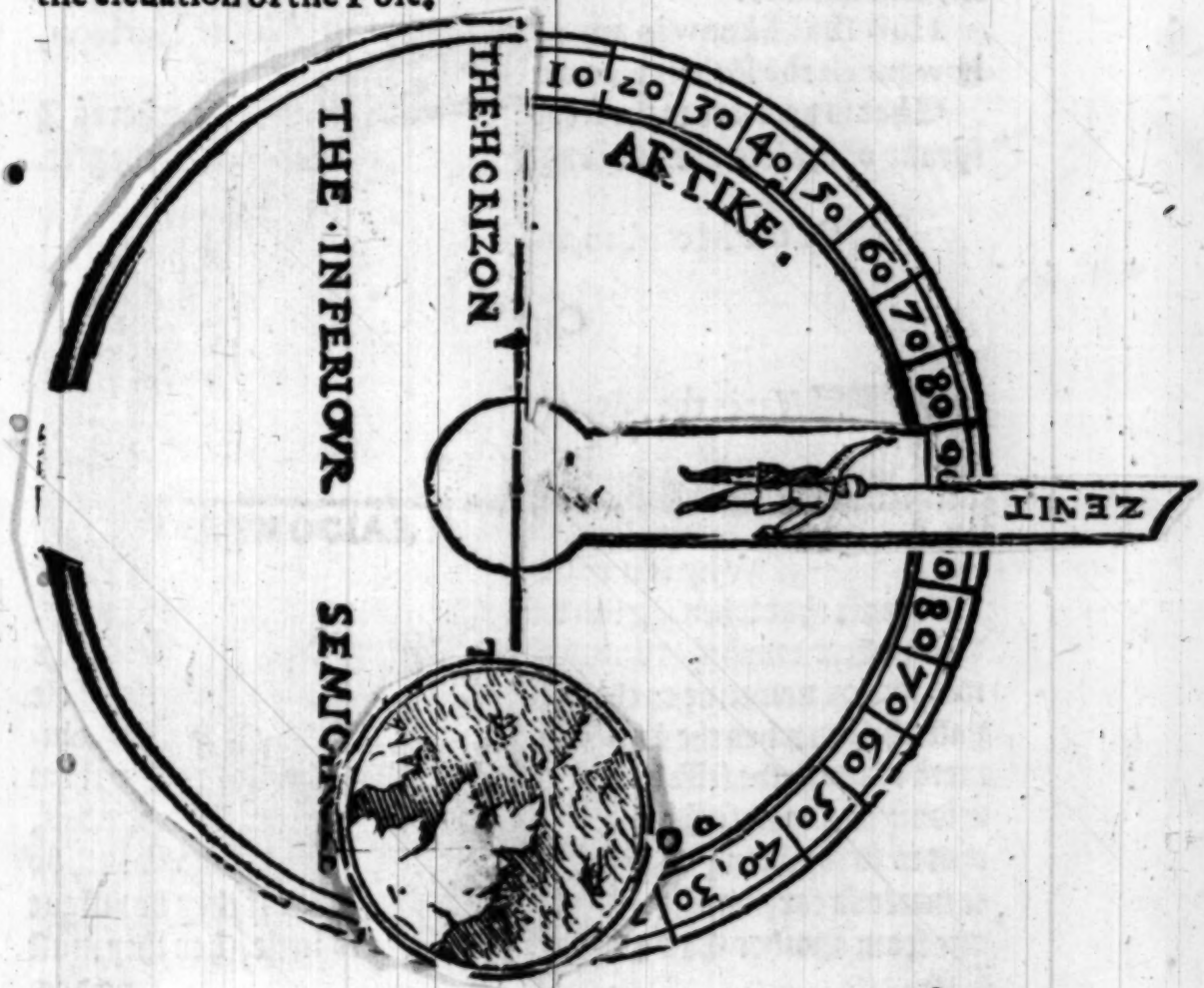
It may be said to be right two manner of waies, first, when the Horizon passeth through both the Poles of the world, cutting the Equinoctiall with right angles, in which Spheare they that dwell haue their Zenith in the Equinoctiall, which passeth right ouer their heads, to whom the daies and nights are alwaies equal. Secondly, they are said to haue a right Horizon, & to dwell in a right Spheare, to whom one of the Poles of the world is their Zenith, and their Horizon is all one with the Equinoctiall, cutting the Arletræ of the world in the very midst with right angles, and because the Horizon & the Equinoctial are Paralels, this kind of Spheare is called a paralel Spheare, in which Sphear they that dwel haue 6. moneths day, and 6. moneths night, as you may easily perceiue by placing the Spheare, so as one of the Poles may stand right vp in the midst of the Horizon, by meanes wherof you shal see 6. signes of the Zodiaque to be alwayes aboue the Horizon, and 6. signes to be alwayes vnder the Horizon: Againe by placing the Spheare so as both the Poles may lie vppon the Horizon, you shall see the shape of the first right Sphear, wherin the Horizon passeth through both the Poles of the world, and the Equinoctiall passeth through the Poles of the Horizon, which are the two points called before the Zenith and Nadir.

When is it said to bee an oblique *H*orizon, and thereby to make an oblique Spheare?

When the Pole of the world is eleuated aboue the Horizon, bee it neuer so little, so as the Horizon doe cut the Equinoctiall with oblique angles, and looke how much the Pole of the world is eleuated aboue your Horizon, so much is your Zenith distant from the Equinoctiall, and the nigher that your Horizon approcheth to the Pole, the nigher your Zenith approcheth to the Equinoctial. Againe, looke how much the Equinoctiall is eleuated aboue your Horizon, so much is your Zenith distant from the Pole, all which things

things this figure here following doth plainely shew, whereby you may easily perceiue that the latitude, which is the distance of your Zenith from the Equinoctiall, is alwaies equall to the altitude of the Pole, which is the distance betwixt your Horizon & the Pole, as for example, knowing the latitude of *Norwich* to be 52. degrees lay the Zenith of this figure vpon the 52. degrees, reckoning from the Equinoctiall towards the pole Arctique on your left hand, and looke what distance is betwixt the saide Zenith and the Equinoctiall, the selfe same distance you shall find to be betwixt the Horizon and the foresaid Pole on your right hand, and you may doe the like vpon the Spheare it selfe by raising the mouable Meridian aboue the Horizon at that altitude, so as the 52. degr. may be euen with the Horizon.

A Figure shewing the latitude of any place to bee equall to the eleuation of the Pole.



through your bodie both head and feet, which is called the Arletræ of the Horizon, and you haue to vnderstand that of Horizons there be 2. kinds, that is, right & oblique, making 3. kinds of Spheares, that is to say, the right Spheare, the paralel Spheare, and the obliqne Spheare.

When is the Horizon said to be right, and thereby to make a right Spheare?

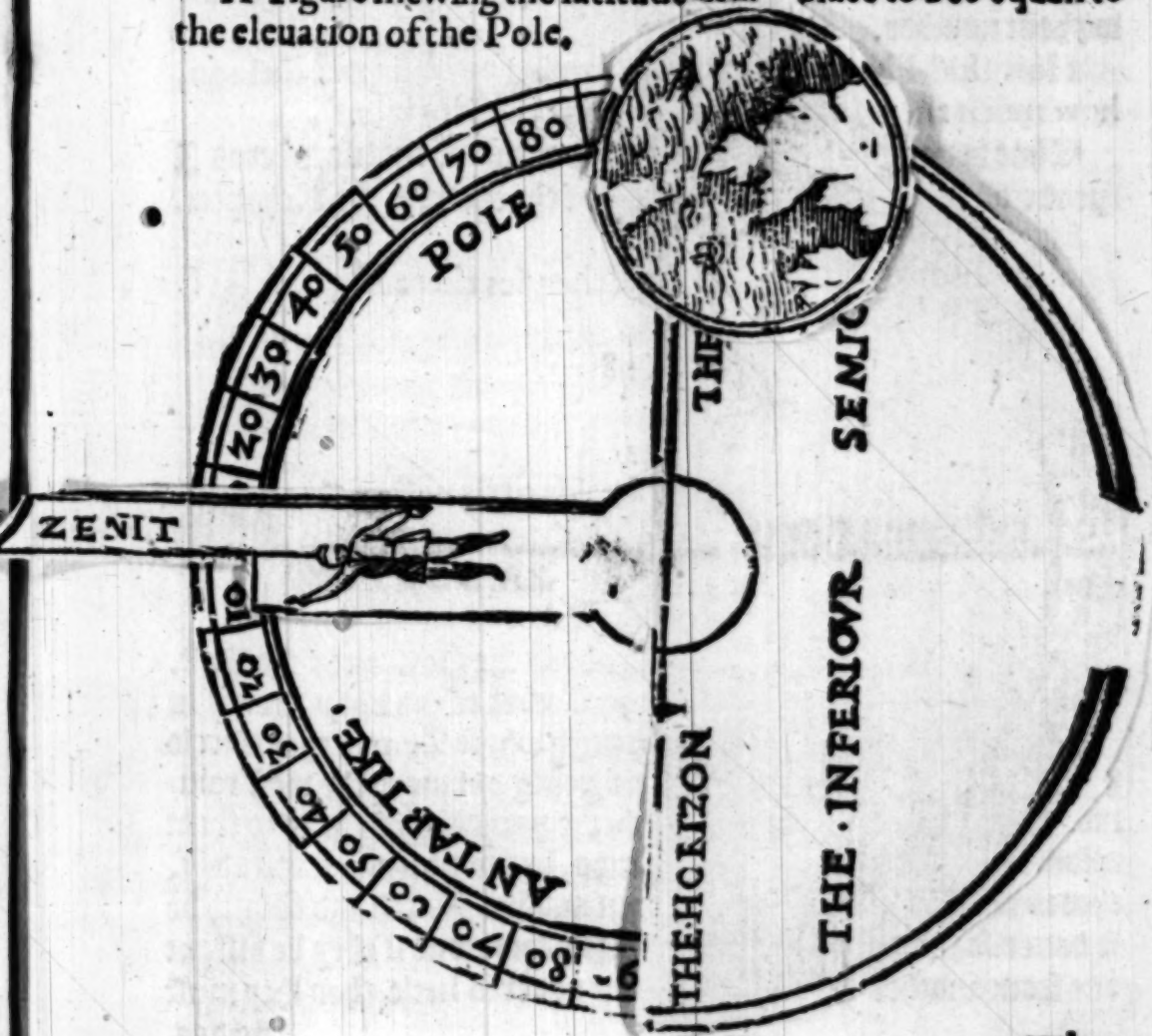
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A Figure shewing the latitude of any place to bee equall to the eleuation of the Pole.



What

What other vses hath this Circle?

In this circle are set downe the foure quarters of the world, as East, West, North and South, and the rest of the winds: Againe, this circle deuideth the artificiall day from the artificiall night, for all the while that the Sun is aboue the Horizon it is day, & whilest it is vnder the same it is night. And by this circle wee knowe what starres do continually appeare, and which are continually hidden, also what starres doe rise and goe downe. Againe, in taking the eleuation of the Pole, this circle is chiefly to be considered, for when we know how many degrees the Pole is raised aboue the Horizon, then we haue the eleuation therof for that place. For to euery seuerall place, yea to euerye little moment of the earth in an oblique Spheare, belongeth his proper Horizon and seuerall altitude of the Pole, whereby it appeareth that the Horizons are infinite and without number.

How shal I know in any place, hauing an oblique Horizon, how much the Pole is eleuated aboue the Horizon?

That is declared in the second booke of this Treatise, whereas I speake of the latitude and longitude of the earth, in the 8. chapter.

Of the Meridian, and of the vses thereof.

Cap. 18.

WHat is the Meridian?

It is a great immœuable circle passing through the Poles of the world, and through the Poles of the Horizon.

Why is it called the Meridian?

Because that when the sun rising aboue the Horizon in the East, commeth to touch this line with the Center of his body, then it is midday or noonetide to those, through whose Zenith that Circle passeth. And when the Sun after his going downe in the west commeth to touch the selfe line againe in the point opposit, it is to them midnight, and note that diuers Cities, hauing diuers Latitudes, that is to say, being distant one from another North and South be it neuer so far, may haue one selfe Meridian: but if they be distant one from another East & West, bee it neuer so little, then they must

nædes

nedes haue diuers Meridians, and such distance betwixt the two seuerall Meridians, is called the difference of Longitude whereof we shall speake hereafter more at large when we come to treate of the Longitude and Latitude of the earth, which something differeth from the Longitude and Latitude of the starres or Planets, whereof we haue already spoken in the 11. Chapter.

How many Meridians be there?

The Astronomers doe appoint for euery two degrées of the Equinoctiall a Meridian, so as they make in all 180. Albeit most commonly in the Spheare they set downe but one, which serueth for all by turning the body of the Spheare to it, which for ỳ cause is called the moueable Meridian. And in such Spheares as haue not a foote and a standing Horizon, there is no Meridian at al, but the two Colures are faine to supply their want, but all terrestriall Globes are commonly described with twelue Meridians, cutting the Equinoctiall in 24. points, and deuiding the same into 24. spaces, euery space containing 15. degrées, which is an houre, by meanes whereof we know how much sooner or latter it is noontide in any place, for it is noonetide sooner to those whose Meridian is more Eastward then to them whose Meridian is more Westward And contrariwise the Eclipse of the Sun or Moone appeareth sooner to those whose Meridian is more Westward.

What other vses hath this circle?

This circle deuideth the East part of the world from the West and also it sheweth both the North and South, for by turning your face towardes the East, you shall finde the Sunne being in that line at noonetide to bee on your right hand right South, the opposit part of which circle sheweth on your left hand the North. Also this Circle by reason that it passeth through both the Poles of the world, deuideth both the Equinoctiall and all his Paralels into two equall parts as well aboue the Horizon as vnder the Horizon, and by that meanes it deuideth the artificial day and artificiall night each of them into two parts, that is to say, into two semidiurnall and into two seminocturnall parts. For betwixt that part of the Horizon where the Sun riseth, mounting still vntill he come to this Circle, which is at noonetide, is contayned the first halfe of the day, & the other halfe is from the same circle to the going down of the Sunne vnder the Horizon. And the first parte of the night is

the space betwixt the Suns going down and his comming againe to the Meridian, which is at midnight, and from thence to the time of his rising is the other halfe of the night, and also the Astronomers take the beginning of their naturall day from this circle, counting either from noontide to noontide, or else from midnight to midnight. Againe, this circle sheweth the right ascentions and declinations of the starres, and the highest altitude, otherwise called the Meridian altitude of the Sun or of any star, or degrée of the Ecliptique, or of any other point in the firmament, al which vses and many others more you shal better vnderstand hereafter, when wée come to shew the vses of the globe as well terrestriall as celestiall.

Of the verticall circles, and vses thereof.

Cap. 13.

BVt here you haue to note that though the most part of Geographers doe set downe in their Spheares but 6. great circles, yet ther is another great circle called the circle Verticall, which passeth right ouer our heades through out Zenith, whersoeuer we be vpon the land or sea, crossing our Horizon in 2. points opposite, and deuiding the same into two equall parts, and such kind of circles are called in Arabick Azimuthes, whereof you may imagine that there be so many as ther be rombes or winds in the Marriners compasse, which are in number 32. yea, and if you will, you may make halfe so many as there be degrées in the Horizon, which are in nũber 360. the halfe whereof is 180. If you be right vnder the Equinoctiall, and doe goe or saile right East or West, then the Equinoctiall is your Verticall circle, and if you goe or saile right North or South, then the Meridian is your verticall circle, which two circles notwithstanding do alwaies kéepe their names. But in sayling by any other rombe, that circle which is imagined to passe from the true East pointe right ouer your head vnto the true West point, or which crosseth your Meridian in the Zenith point with right Spherical angles, is most properly called the verticall circle, and the learned seamen haue great respect to two speciall kinds of Verticall circles, that is, the Magneticall Meridian, and the Azimuth of the Sunne.

What manner of verticall Circles bee those, and whereto serue they?

M. Borrough in his discourse of the variation of the Compasse, defineth the Magneticall Meridian to bee a great Circle, which passeth through the Zenith and the Pole of the load stone called in Latine Magnes, and deuideth the Horizon into two equall parts, by crossing the same in two points opposite. Againe the Azimuth of the Sunne is a great Circle, passing through the Zenith and the Centre of the Sunne in what part of the heauen so euer he be, so as he be aboue the Horizon, which Circle deuideth the Horizon into two equall parts by crossing the same in two points opposite. And by helpe of these two Circles and a certaine instrument made of purpose to giue a true shadow, he teacheth to finde out the true Meridian of any place: And also to know how much any Mariners Compasse doth varie from the true North and South, in North-easting or North-westing, whereof I shall speake more at large hereafter in my treatise of Nauigation.

What vse is there of the verticall Circles, or Azimuthes?

The verticall Circle sheweth what time the Sunne or any other starre rysing beyond the true East pointe, is passed that Sunne or saide starre, commeth to the true East or anye other rombe. Also in what Coast or part of heauen, the Sunne, Moone, or any other starre is at any time being mounted aboue the Horizon, as whether it bee Southeast or Northeast, or in any other rombe: Also by helpe of the verticall Circle most properly so called, are the twelue houses of heauen set, according to Campanus and Gazula. And by helpe of these Circles you may also knowe how any place vppon the earth beareth one from another eyther Eastward or Westward, and so forth, for euerie place hath his seuerall Azimuth aunswerable to the Horizon and Zenith of the saide place.

Of certaine Circles called Almicanterathes?

Since I haue spoken heere somewhat of the verticall Circles called Azimuthes, it shall not be amisse to shew you also that there be other Circles to bee considered of in the Spheare as well as in the Astrolabe called Almicanterathes, that is to say, Circles of Altitude, which though they be not al great Circles, for euery one

is lesser then other proceeding frō the oblique Horizon of any place to the Zenith of the said place, yet the first Almicanterath which is the verie oblique Horizon it selfe, is a great Circle deuiding the Spheare into two equall parts, and all the rest are lesser and lesser, vntill you come to the verie Zenith, and are paralels to the Horizon, euen as the Tropiques and the other lesser Circles are paralels vnto the Equinoctiall. And the Zenith in Spherical bodies is the Centre of them all, though it bee not so in Astrolabes, for there euerie Almicanterath is faine to haue his seuerall Centre, of which Circles there be in all 90. according to the number of 90 degrees contained betwixt the oblique Horizon and the Zenith, and these Circles doe serue to shew the Altitude of the Sunne or Moone, or of any other starre fixed or wandring, being mounted at any time aboue the oblique Horizon, which is easie to bee found by any Quadrant, Crosse-staffe, or Astrolabe. But leauing to speake any further of these Circles, because they are not vsed to be described in Spheares but onely in Astrolabes, I will now treate of the foure lesser Circles before mentioned, which are commonly set downe in euery Spheare or Globe.

Of the foure lesser circles, that is to say, the circle Arctique, the circle Antarctique, the Tropique of Cancer, and the Tropique of Capricorne, and also of the fiue Zones, that is to say, two cold, two temperate, and one extremely hoat.

Cap. 20.

WHich call you the lesser Circles?

They are those that doe not deuide the Spheare into two equall parts, as the great Circles doe, and of such there bee foure, that is the two Polar circles, and the two Tropiques, that is to say, the Tropique of Cancer, and the Tropique of Capricorne, of which Polar circles the one is called Arctique, and the other Antarctique, and are made by the turning about of the two Poles of the Zodiaque, which Poles being situated in the Colure of the Solsti-

Solstices are so farre distant from the Poles of the world, as is the greatest declination of the Sunne from the Equinoctiall, which is 23. degrées, 28. as hath beene said before.

Which is the Arctique Circle, and why is it so called?

The Arctique Circle is that which is next to the North Pole, and hath his name of this worde Arctos, which is the great Beare or Charles wayne, which are seuen starrs placed next to this Circle on the outside thereof, and it is otherwise called the Septentrionall Circle of this word Septentrio, which is as much to say as seuen Oxen, signified by the seuen starrs of the little Beare, which doe moue slowly like Oxen, and are placed all within the sayde Circle, and the bright starre that is in the tippe of the tayle of the sayde little Beare, is called of the Mariners the wade starre or North starre, whereby they sayle on the Sea, and the Centre of this Circle is the North Pole of the world which is not to be seene with mans eye.

What is the Antarctique Circle?

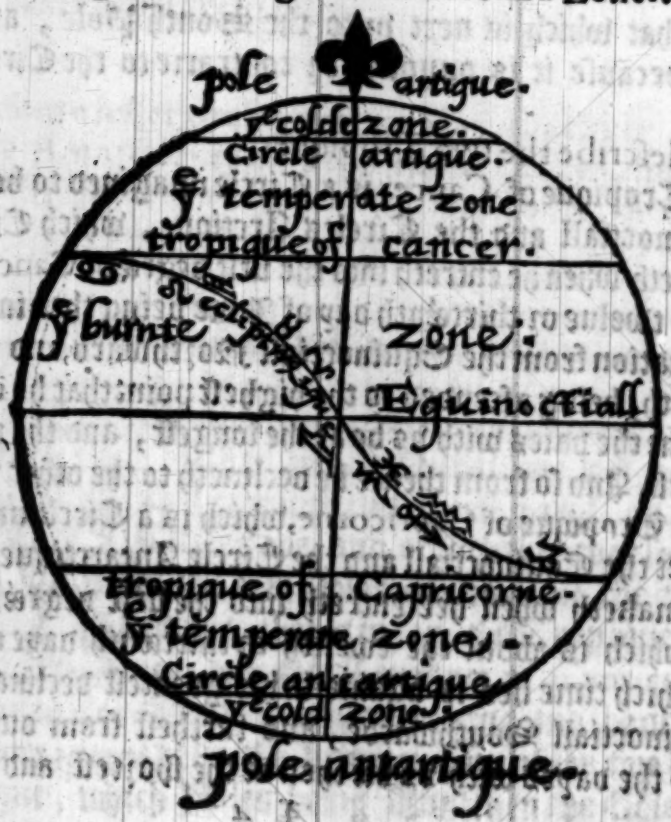
It is that which is next vnto the South Pole, and it is so called, because it is opposite or contrarie to the Circle Arctique.

Now describe the two Tropiques.

The Tropique of Cancer is a Circle imagined to bee betwixt the Equinoctiall and the Circles Arctique, which Circles the Sun maketh when he entreth into the first degrée of Cancer, which is about ỳ twelue or thirteuth day of June being then in his greatest declination from the Equinoctiall Northward, and nighest to our Zenith, being ascended to the highest point that he can goe, at which time the daies with vs be at the longest, and the nightes at the shortest. And so from thence he declineth to the other Tropique called the Tropique of Capricorne, which is a Circle imagined to be betwixt the Equinoctiall and the Circle Antarctique, which the Sunne maketh when hee entreth into the first degrée of Capricorne, which is about the twelfth or thirteuth daye of December at which time hee is againe in his greatest declination from the Equinoctiall Southwarde, and furthest from our Zenith: whereby the dayes with vs be then at the shortest, and the nights

at the longest: And note that these two Circles are called Tropiques of this Greeke word Tropos, which is as much to say as a conuersion or turning, for when the Sunne arriueth at any of these two Circles, he turneth backe againe either ascending or descending, by reason of which foure Circles as well the firmament as the earth is deuided into fiue Zones, that is to say, two colde, two temperate, & one extremely hoat, otherwise called the burnt Zone, of which fiue Zones, the foresaid foure circles are the true bounds. For of the two cold Zones, the one lyeth betwixt the North pole and the Circle Arctique, and the other lyeth betwixt the South Pole and the Circle Antarctique, & of the two temperate Zones, the one lyeth betwixt the Circle Arctique, & the Tropique of Cancer, and the other lyeth betwixt the Circle Antarctique, and the Tropique of Capricorne, & the extreme hoat Zone lyeth betwixt the two Tropiques, in the middest of which two Tropiques, is the Equinoctiall line, as you may see in this figure and also in the Spheare or Globe it selfe.

A figure shewing the fiue foresaid Zones.



Of which Zones the auncient men were wont to say that thrée were vnhabitable, that is, the two colde, and the extreame hoat, which experience sheweth in these latter daies, to be vntrue, as we shall declare more at large when we come to treate of the diuision of the earth: Againe you haue to vnderstand that euery one of these lesser Circles doth containe in length, 360. degrées as well as euery one of the greater Circles, but the degrées are not of like bigneſſe, no more then the Circles themselues are like in compaſſe or circuit, for the lesser the Circles are in circuit, the lesser their degrées must néedes be.

Sith euery of the lesser Circles differ one from another in circuit, and thereby the degrees of euery Circle be lesser then other, how shall I know the true quantitie of euery degree in ech Circle, and how manye minutes are required in euerie lesser degree proportionally to answere one degree of the Equinoctiall.

For the better knowledge hereof, you must first imagine that there maybee as many Circles made from the Equinoctiall towards any of the Poles, as there be degrées of Latitude, which are in number 90. as hath béene said before: And the nigher that any circle is to the Equinoctiall, the greater it is in circuit, and the further from the Equinoctiall towards any of the Poles, the lesser in circuit, and therfore more or lesse minutes are requisite to answere to one degrée of the Equinoctiall, as you may easily perceiue by this Table following, consisting of 6. collums, euery front or head whereof is noted with thrée great letters, D. M. S. signifying degrées, minutes and seconds, fiue times repeated, and in the beginning of the first collum on the left hand is set downe one degrée, which is the first degrée of 90. and nigheſt vnto the Equinoctiall, right against which one degrée is placed towards the right hand, 59. minutes, and 59. seconds: and so proceeding from degrée to degrée ſuccessiuely, vntill you come to 90. you shall finde how many minutes and seconds doe answere to one degrée of the Equinoctiall, and this Table will also serue to shew the difference of miles in euery sundry clyme or paralell, whereof we shall speake hereafter when we come to treat of the earth.

A Table shewing how many minutes are requisite to make one degree, in euery lesser Circle answerable to one degree of he Equinoctiall.

D	M	S	D	M	S	D	M	S	D	M	S	D	M	S	D	M	S
1	59	59	16	57	41	31	51	26	46	41	41	61	29	5	76	14	31
2	59	58	17	57	23	32	50	53	47	40	55	62	28	10	77	13	30
3	59	53	18	57	4	33	50	19	48	40	9	63	27	14	78	12	28
4	59	51	19	56	44	34	49	45	49	39	22	64	26	18	79	11	27
5	59	46	20	56	23	35	49	9	50	38	34	65	25	21	80	10	25
6	59	40	21	56	1	36	48	32	51	37	46	66	24	24	81	9	23
7	59	33	22	55	38	37	47	55	52	36	56	67	23	27	82	8	21
8	59	25	23	55	14	38	47	17	53	36	7	68	22	29	83	7	19
9	59	16	24	54	49	39	46	38	54	35	16	69	21	30	84	6	16
10	59	5	25	54	23	40	45	58	55	34	25	70	20	31	85	5	14
11	58	54	26	53	56	41	45	17	56	33	33	71	19	32	86	4	11
12	58	41	27	53	28	42	44	35	57	32	41	72	18	32	87	3	8
13	58	28	28	52	59	43	43	53	58	31	48	73	17	33	88	2	5
14	58	13	29	52	29	44	43	10	59	30	54	74	16	32	89	1	3
15	57	57	30	51	58	45	42	26	60	30	0	75	15	32	90	0	0

Of the starres and celestiall bodies contained in the firmament, and first of their substance.

Cap. 21.

HAuing briefely described all the Circles as well greater as lesser that are imagined to be in the 8. heauen, I thinke it good now to speake somewhat of the starres and celestiall bodies placed in the saide heauen, And first of their substance, and then of their mooning, figure, shape, number, magnitude or greatnes, also of their Longitude, Latitude

Latitude, declination, ascention, descention both right and oblique, and of the ascentionall difference, and finally of the threefold Poeticall rising and going downe of the starres, but first of their substance.

Of what substance are the starres?

The stars be of the same substance that the heauens are wherein they are placed, differing onely from the same in thicknes, and therefore some defining a starre doe say, that it is a bright and shining body, and the thickest part of his heauen, apt both to receiue and to reteine the light of the Sunne, and therby is visible and obiect to the sight: for the heauen it selfe being most pure, thinne, transparent, and without colour is not visible, and for this cause the milke-white impression in heauen like vnto a white way called of the Astronomers Galaxia, and of the common people our Ladies way, is visible to the eye, by reason that it is thicker then anie other part of the heauen.

Why are not the starres seene as well in the day, as in the night.

Because they are darkened by the excellent brightnesse of the Sunne from whome they borrowe their chiefest light.

Of the mooving and shape of the starres.

Cap. 22.

WHat mooving haue the starres?

The selfe same mooving that the heauen hath wherein they are placed.

Whereby are the heauens mooued?

Some say that the first moueable is turned by God himselfe, and all the rest of the heauens euery one by his proper intelligence, which though it turneth his heauen about, yet it giueth neither life, sense, nor vnderstanding thereunto, as some haue vntruely holden, affirming the heauens to be liuing and intelligible bodies.

If

If the starres haue no mooving of themselues, whereof commeth it then, that some seeme to our sight sometime nigher & sometime further off.

All the fixed starres of the firmament are alwayes of like distance, notwithstanding by reason of the manyfold mouing of the firmament, wherein they are placed, they seeme to change their places, and sometimes to bee more towardes the East or West, North or South. And whereas the vii. Planets called the wandring starres, doe change their places now here now there, that chanceth not by their owne mouing, but by the mouing of the heauens wherin they are placed: for a starre being round of shape hath no members meete to walke from one place to another, but onely changeth his place through the motion of his Spheare or heauen wherein such Planet is fixed.

Of the number of the stars, and of their magnitude or greatnesse, and into how many Images they are deuided, and how many starres euery Image containeth.

Cap. 23.

MAy the starres be numbred by man? No, for as Dauid saith, that belongeth onely to God, who as hee created them, so hee can number them and call them all by their names, notwithstanding the Astronomers by their industrie and diligent obseruation, haue attained to the knowledge of manie: as first they know the seuen Planetes, otherwise called the wandringe starres, and haue made manifest demonstrations of their motions, and by continuall obseruation haue found out the manifolde vertues, powers and influences of the same, but of the fixed starres they could neuer finde more then 1022. and because the starres are not equall in greatnes or bignesse, they make sixe differences of greatnesse, appointing to the first difference 15. starres, which are bigger then all the rest, whereof euerie one containeth the earth 207. times, to the seconde difference 45. starres, whereof

euery

euery one containeth the earth 90. times. To ỳ third they appoint 208. starres, whereof euery one containeth the earth 72. times. To the fourth difference they appoint 474. starres, whereof euery one containeth the earth 54. times. To the fift they assigne 217. starres, whereof euery one containeth the earth 57. times. To the sixt or last greatnesse they appoint 49. small starres, whereof euery one containeth the earth 18. times, and some say 20. times. Besides these there be 14 others, whereof 5. be called cloudy and the other darke, because they are not to be seene but of a very quicke and sharpe sight. And you haue to note that the auncient Astronomers do deuide all the fixed starres to them known into 48. images, wherof they liken some to liuing things as to men, women, beasts, monsters, foules, fishes, and creeping wormes, and some to things without life, hauing some artificiall shape, of which 48. images, they appoint 12. to the Zodiaque, commonly called the 12. signes, as Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricornus, Aquarius and Pisces. Againe they place in the North part of the firmament 21. images, and in the South part thereof 15. images, which make in all 48. The description of all which images, together with their names hereafter followeth: and first I will describe vnto you the twelue Images contained in the Zodiaque.

Of the xii. Images or signes of the Zodiaque.

Cap. 24.

THe twelue signes (as some affirme) doe containe of the foresaide number of fixed stars 273. for the first signe called Aries, that is to say, the Ramme, containeth 13. starres, which Image or signe being placed in the coniunction of the Zodiaque with the Equinoctiall, hath his backe turned towardes the North, and his head towardes the East, and riseth with his head, and goeth downe with his feete. The second signe called Taurus, that is to say, the Bull, containeth 33. starres, whereof there is one bright starre of the

first

first bigneſſe called Oculus Tauri, that is to ſay, the Bulles eye, who hath his head enclyned towards the Weſt as though he loked towards the earth, and riſeth and goeth downe with his hæles vpwarde. The thirde Signe called Gemini, that is to ſaye the twinnes, doe containe 18. ſtarres, their heads looking towards the North, and their backes being ioyned together doe embrace one another, doe riſe lying, and doe goe downe with their feete. The fourth Signe called Cancer, that is to ſaye, the Crabbe containeth nine ſtarres, extending his feete towardes both the Poles, and looking towards Leo, hath his bellie turned towards the earth, and hee riſeth and falleth with his hinder part or backe part of his bodye. The fifth Signe called Leo, that is to ſaye the Lyon, containeth ten ſtarres, whereof there bee two bright ſtarres of the firſt bigneſſe, the one in his breaſt called Cor Leonis, and Regulus, that is to ſay the Lyons heart, and the other in his tayle called Cauda Leonis, that is to ſaye, the Lyons tayle, who looketh towardes Cancer, and hauing his backe turned towardes the North, hee riſeth and goeth downe with his head. The ſixt Signe called Virgo, that is to ſaye, the Virgine, whoſe head is behinde the Lyon and toucheth the Equinoctiall line with her left hande, holding in the ſame hande an eare of Corne, ſhee both ryſeth and goeth downe with her head: this Image containeth ſixe and twentie ſtarres, whereof there is one bright ſtarre of the firſt bigneſſe called Spica Virginis, that is to ſaye, an eare of Corne. The ſeuenth Signe called Libra, that is to ſaye the Ballance, containing eight ſtarres hath two ſkales, whereof the one hangeth towardes the North, and the other towardes the South. The eight Signe called Scorpios, that is to ſaye the Scorpion, containeth one and twentie ſtarres, who looketh towardes Virgo, and extendeth his feete towardes both the Poles, hee boweth his tayle towardes the North, hauing his bellie turned towardes the earth, and hee ryſeth and goeth downe bowing. The ninth Signe called Sagittarius, that is to ſaye the Archer, containing one and thirtie ſtarres, hath his heade towardes the North, and looketh towardes the Scorpion, hauing a bowe and a ſhaft, whereof the bowe toucheth his left hande and left foote, hee riſeth right vppe and goeth downe headlong. The tenth ſigne called Capricornus, that is to ſaye, the Goate containing eight and twentie ſtarres,

hath

hath his backe turned towardes the North, and his head towards the Archer, and turning himselfe towardes Aquarius, hée ryseth right vp, and goeth downe headlong. The eleauenth Signe called Aquarius, that is to saye, the water bearer containing two and fourtie starres, hath his heade towards the North, extending his left hande vppon the backe of Capricorne, and with his right hande powreth out water out of his potte, which bendeth towards the East, runneth euen to Pisces, hée ryseth and goeth downe with his heade before anye other of his members. The twelueth Signe called Pisces, that is to saye, two Fishes, doe containe foure and thirtie starres, wherof the backe of the first is towards the North, and the backe of the seconde towardes the West arme of Andromeda, and one of the Fishes looketh towardes Aquarius, and the other towardes the North, and betwixt these two Fishes is a certaine little line wherewith their tayles are bounde together as it were with a bond, the lower part of which Fishes, doth alwaies both ryse and goe downe, and not the vpper part: And though the 12. Signes of the Zodiaque are said to bé equall both in length and breadth, that is to saye, hauing thirtie degrées in length, and twelue degrées in breadth, as hath béene sayde before, yet these Images are not equall, for some doe extende, further then the Zodiaque in breadth, and some are more then 30. degrées in length, As the Tables of Alphonsus doe manifestly shewe, who sayeth there that the twelue Signes doe containe thrée hundred and fiftie starres, for he appointeth to Aries eighténe, to Taurus fourtie foure, to Gemini twentie fiue, to Cancer thirténe, to Léo thirtie fiue, to Virgo thirtie two, to Libra seuenténe, to Scorpio twentie foure, to Sagittarius thirtie and one, to Capricornus twentie eight, to Aquarius fourtie fiue, to Pisces thirtie eight, which make in all thrée hundred and fiftie, in which Tables are also set downe the Longitude, Latitude, and Magnitude of the saide starres, but the Longitude of the saide stars, is farre altered from that Longitude which they had in his time, whereof we shall speake hereafter more at large.

Of

Of the xxi. Northerne Images.

Cap. 25.

WHich be they?

These here following, first Vrsa minor, ỹ is to say, the lesser Beare containing 7. stars, the taile starre whereof being a bright star of the third bignesse is called the loadstarre: The second is called Vrsa maior, that is to say, the great Beare containing 27. starres, whereof there be 7. principall, making a shape like vnto a Cart with foure wheeles, and therefore it is commonly called Charles waine. The third is called Draco, that is to say the Dragon that kept Iunos Orchard from robbing, containing 31. stars. The fourth is called Cepheus, the proper name of a King of Ethiope, containing 11. stars. The fift is called Bootes, that is to say the roaring keeper of the Beare, containing 22. starres, whereof there is one bright star betwixt his legges, of the first bignesse called Arcturus. The sixth is called Corona Ariadnæ, that is to say the Crowne of Ariadna the daughter of king Minos, containing 8. starres. The seuenth is Hercules, who lyeth groueling with his heeles towards the North pole, holding a clubbe in his right hand, and a Lions skin hanging on his left arme containing 28. starres. The eight is called Lira, that is to say an instrument of musicke like a Harpe placed in heauen in the memorie of Orpheus, containing 10. stars. The ninth is called Cignus, that is to say the Swanne, into which Iupiter transformed himselfe to deceaue the Nymph Læda, containing 17. starres. The tenth is called Cassiopeia sitting in her chaire, wife to Cepheus, and mother to Andromeda, containing 13. stars. The eleuenth is called Perseus, holding his sworde in the one hand, and the head of Gorgon or Medusa in the other hand, whose haires were all Serpents, containing 26. starres. The twelfth is Auriga ℞ Erichthonius, who was the inuentor of the first Chariot that euer was made, containing 13. starres. The 13. is called Serpentarius and Anguitenens, that is to say, he that holdeth the Serpent, who as some thinke was Æsculapius the famous

Phisitian,

Philitian, containing 24. starres. The 14. is called Serpens or Anguis, that is to say, the Serpent of Esculapius containing 18. starres. The 15. is called Sagitta or Telum, that is to say the shaft or dart wherewith *Hercules* slew the Eagle tormenting Prometheus in the mount Caucasus, containing 5. stars The 16. is called Aquila, that is to say, the Eagle which caried Gammedes into heauen containing 9. starres. The 17 is called Delphinus that is to say the Dolphyn, which saued Arion that excellent Musitian, being cast by Pyrats into the sea, containing 10. stars. The 18. is called minor Equus, that is to say, the lesser Horse, containing only 4. little darke stars in his head. The 19. is the great Horse called Pægasus, that is to say the winged Horse, wherewith Bellerophon conquered the monstrous beast called Chimera, which was halfe a Lyon and halfe a Dragon, and is adorned with 20. starres. The 20. is called *Andromeda* the daughter of Cepheus by Cassiopeia, and wife to Perseus, who for her constant loue towards her husband, was placed in heauen nigh vnto him, and was adorned with 23. starres. The 21. is called Triangulum, that is to saye a Triangle or thrée cornerd figure, which being like in shape to the Ile Cicilia the Goddesse Ceres obtained to be placed in heauen, & was adorned with 4. starres, that is to say, euery corner one, & the fourth in the midst of the shortest side: To these (in mine opinion) ought to be added Bernices haire, called crinis Bernices, which in all celestiall globes is placed not farre from the right hinder foote of the great Beare, and this Image containeth 4 little starres.

Of the 15. Southerne Images.

Chap. 26.

WHich be they?

These hereafter following, whereof the first is called Cætus, that is to saye the Whale, that monstrous fish which by the appointment of Neptune, would haue destroyed Andromeda, whome Perseus deliuered by killing the Fishe, and afterwardes tooke Andromeda to wife, which Fishe Neptune placed in heauen, adorning the same with two and twentie starres.

The second is called Orion with his sword by his side, who afterwarde was slaine by Diana by mis-hap against her will, for the which she placed him in heauen, adorning him with 38. Starres, whereof there be two bright starres of the first bignesse, the one in his right shoulder called Bed Alguze, and the other in his left foote called Rigell Alguze. The third is the flood called Eridanus, into the which Phaeton the sonne of Apollo was stroken with a thunderbolt by Iupiter, for burning the earth by rashly driuing his fathers Chariot, which he was not able to guide, in memorie whereof the flood was placed in heauen, and adorned with 34. Starres, whereof one is a bright starre of the first bignesse called Acarnar. The fourth is called Lepus, that is to say the Hare, placed nigh vnto Orion, because he was a hunter, adorned with 12. starres. The fift is called Canis maior, that is to say the great Dogge, passing all others in swiftnesse, which was giuen by Aurora to Cepheus the sonne of Eolus, and is placed next to the Hare, being adorned with 18, starres, whereof there is in his mouth a very faire starre of the first bignesse called Syrius. The sixth is called Canis minor, that is to say, the lesser Dogge, without the which Orion his maister would not bee placed in heauen, which hath but two Starres, whereof the one is in his flanke, and is a bright star of the first bignesse called Canicula and Procion. The seuenth is the ship called Argos, in the which Iason and his companions sayled to Colcos to winne the Golden Fléese, which is adorned with 45. starres, whereof ther is one bright starre of the first bignesse in the left oare called Canopus. The eight is called *Hydra*, that is to say ꝑ Water-serpent which Hercules slewe, or as some say which kept the waterbowle, and woulde not suffer the thirstie Crowe to drinke, which Crowe Apollo sent for water to doe sacrifice, and is adorned with 25. starres. The ninth is called Crater, that is to say the Cuppe or Bowle which the Crowe brought too late vnto Apollo, and therefore his feathers were made all blacke whereas before they were white, containing 7. starres. The tenth is called Corvus that is to say the Crowe before mentioned, adorned with 7. starres. The 11 is called Chiron siue Centaurus, the sonne of Saturne passing all others in iustice and religion, and therefore is figured in heauen as though he were offring sacrifice vpon an altar adorned with 37. starres whereof there is one bright starre of the first bignesse in

his

his right foote called Chiron and Centaurus. The twelfth is called Lupus, that is to say the Wolfe, into which Licaon the cruell Tirant was turned by Iupiter, or as some say that Wolfe which Centaurus killed to do sacrifice vpon the altar containing 19. starrs The thirteenth is called Ara, that is to say the Altar made by the Smithes of Vulcane, whereupon all the Goddes sware to reuenge the insolencie and pride of the Giants, which altar is placed next to Centaurus being adorned with 7. starres. The fourteenth is called Corona Australis that is to say, the Southerne Crowne which Bacchus did weare when he fetched his mother Semele frō hel, which is placed in heauen, & is adorned with thirteene starres. The fifteenth and last of the Southern signes is called Piscis Australis, that is to say, the Southerne Fish which was placed in heauen in memoriall of the fishes which the people of Syria did worship as their Goddes, and is adorned with 12. starrs, whereof there is one bright starre of the first bignesse in his mouth called Fomahant: All which Images and Signes before mentioned, as well Northerne as Southerne, you may see plainely described in euery celestiall Globe, and also set forth in Plano in the nether ende of Vopellius his vniuersal Map, that is to say the Northerne signes on the left side, and the Southerne signes on the right side of the Map: Or in the front of Planctius his great vniuersall Map, who in the rondle representing the Southerne halfe of the celestiall, Globe, setteth downe also certaine Southerne starres lately found out by the trauellers into the Indies, as the Crosse, the Southern Triangle, Noe his Doue or Pigion, & another in shape of a man called Polophilax, so as ther be now in all 19. southerne Images.

Of the longitude of the fixed starres, and of the præcession of the vernall Equinoctiall point, and what it is.

Cap. 27.

WHat is the Longitude of a starre?

The Longitude of any Starre, is that Arke or portion of the Ecliptique line which is contayned betwixt the first pointe of Aries, and that Circle which passeth through the Poles of the Zodiaque,

and also through the body of the starre, as for example the star called Cor Leonis is distant in these daies from the vernall Equinoctiall point of the Ecliptique line 143. degrees and 32. and thereby is found to be in the 23. degree and 32. of Leo, agame the star called Spica Virginis in these dayes is distant from the first point of Aries 198. degrees, and so is found to be in the eightenth of Libra.

Why doe you say in these dayes?

Because the fixed starres in processe of time, doe change their Longitude by reason of their proper moouing vpon the Poles of the Zodiaque, which is from West to East, for whereas Spica Virginis in Ptolomies time was in the 26. degree of Virgo, it is found now to be in the 18. of Libra, the cause whereof is the precession of the Equinoctiall point or section.

Define what that Precession is?

It is an Arke or portion of the Ecliptique line, contayned betwixt two great Circles, both passing through the Poles of the Zodiaque, in such sort as the one passeth through the first minute of the vernall Equinoctiall point of the saide Ecliptique, and the other Circle passeth through the first or former starre of the Rams horne, from which starre the Astronomers doe make all the celestiall motions and reuolutions to take their first beginning, and this starre in olde time past was knowne to be before the vernall Equinoctiall point, which is the first moment of Aries, but now it is found to haue passed that point so farre towards the Solsticiall point, as in these daies it is knowne to be in the 27. degree and 42 of Aries, and in processe of time it will be cleane out of Aries, and enter into Taurus.

Of the Latitude of the fixed starres.

Chap. 28.

WHat is the Latitude of a starre?

The Latitude is none other thing, but the distance of any starre from the Ecliptique line eyther towards the North or South pole of ỳ Zodiaque, and such Latitude neuer changeth or altereth, for as the starre Spica Virginis is at this present

presently two degrées distant from the Ecliptique line towards the South, so it euer hath béne and euer shall be, and the like is to be said of all the rest of the fixed starres which do alwaies kéepe their Latitude, be it Northward or Southward, nære to the Ecliptique or farre from the same.

Of the Declination of the fixed starres.

Chap. 29.

What is the declination of a starre?

The declination is none other thing, but the distance of any fixed starre from the Equinoctiall, either Northward or Southward, which is mutable as well as the longitude: for as the fixed starres doe change their Longitudes, so also by little and little they decline either more or lesse from the Equinoctiall: As for example, the declination of the starre called Canicula, that is to say the lesser Dogge in the yeare of our Lord, 138. when Ptolomie liued, was 15. degrées 4′ 4. and 3″ 8. towards the South. But in these dayes the declination of the said starre is but fiue degrées and 7′ towards the South, and by reason that the fixed starres in processe of time doe change their Longitude and declination, they are not alwaies vnder one selfe signe, but doe slit out of one signe into another.

How is the Longitude, Latitude, and declination of anye starre to be knowne, and how are the starres themselues to bee knowne in the firmament.

The Longitude, Latitude, and declination of any starre is to be knowne most truely by the Astronomicall Tables calculated of purpose, and you may know the same also without hauing regard to euery small minute, by helpe of the celestiall Globe, all the necessarie vses whereof I haue set downe in a little Treatise to bee added hereafter to this Booke, and there also I shew you how to find out any starre in the firmament that is described in the globe, in which Globe are set downe as many stars as euer were known, a few excepted towardes the South pole, which were founde out but of late dayes, of which starres I shall haue occasion to speake

hereafter in my Treatise of Nauigation. In the meane time I will proceede to the ascention and descention of the Starres both right, meane, and oblique.

Of the ascention and descention, that is the rising and setting of the starres as well according to the Astronomers, as according to the Poets.

Chap. 30.

DOe the Astronomers and Poets differ touching this matter?

Yea they differ greatly as wel in name as in matter: for wheras of the Poets it is called ortus & occasus Signorum, that is to say, the rising and falling of the Signes, so of the Astronomers it is called Ascentio & descentio Signorum, that is to say, the ascention and descention of the Signes, againe they differ in matter, or rather in manner, for that the Astronomers do consider the rising & falling of the starrs more exactly then the Poets, for the Astronomers doe consider the degrees and minutes of the same, and also do ground their ascention and descention vpon more certaine demonstrations then the Poets. Moreouer whereas the Poets by their manner of rising and falling, doe simply set downe the time of things done or to be done, the Astronomers doe the same a great deale more exactly, and by their manner of ascention and descention doe consider the increase and decrease of the dayes, of which the Astronomicall ascention and descention, I mind here to treate first in generall and then in particular.

Of the Astronomicall ascention and descention in generall both right, meane, and oblique, and what a giuen Arke is.

Chap. 31.

DEfine what the Astronomicall ascention and descention is.

Astronomicall ascention is that portion or Arke of the Equinoctiall line which riseth together with some giuen

giuen Arke of the Ecliptique line aboue the Horizon and the descention is that portion or Arke of ỳ Equinoctiall that goeth down or setteth together with some giuen Arke of the Ecliptique line vnder the Horizon, according to the mouing of the world which is from East to West.

What meane you by a giuen Arke?

A giuen Arke is as much to say as some supposed portion of the Ecliptique or of any other Circle, as if you woulde knowe the ascention of some supposed portion of the Ecliptique, contayning for example 25. or 30. degrées, heere this portion of the Ecliptique contayning that number of degrées, is called the giuen Arke, of which Arkes some are called continuall, and some descrete or deuided, which I minde to English here whole and broken, for so I doe English quantitas, continua, & discreta in my Logicke, That Arke is sayde to bee continuall or whole which taketh his beginning from the first point of Aries, and so proceéding orderly, endeth at some other degrée of the saide Ecliptique. And that Arke is called discrete or broken, which doth not take his beginning from the first point of Aries, but beginneth at some other degrée of the Ecliptique, as for example, suppose that it beginneth at the fourteenth of Taurus, and endeth at the fifteenth of Gemini, this Arke is called a deuided or broken Arke, because it doth not beginne at the first point of Aries, and so proceede successiuely: Moreouer you haue to vnderstande that the auncient Astronomers doe commonly make but two kindes of ascention and descention, that is, right and oblique, but there bee in deede three kindes of ascention, that is to saye, right, oblique, and meane ascention.

When is anye ascention sayde to bee right, oblique or meane?

It is sayde to bee right, when the portion of the Equinoctiall which riseth or goeth downe together with the Ecliptique, is greater or more in circuit then that of the Ecliptique. And it is sayde to bee oblique, when that portion of the Equinoctiall which riseth or falleth together with the Ecliptique, is lesser then that of the Ecliptique, Againe that is sayde to bee meane ascention, when that portion of the Ecliptique which ascendeth, is neyther greater nor lesser then that of the Equinoctioll, for as in

the right Spheare euery quarter of the Ecliptique hath a meane ascention, and equall to euery quarter of the Equinoctiall, beginning the quarters at any of the foure principall pointes, so if you take three signes in any other part of the Zodiaque, their ascentions will not agree with a quarter of the Equinoctiall, sith there is no one signe that doth equally agree with the like portion of the Equinoctiall, and all this matter dependeth vpon the knowledge of the vse of certaine Circles before defined.

Which be they?

These three, the Zodiaque, the Equinoctiall, and the Horizon: for first the Zodiaque doth shew the place of the Sunne, that is to say in what degree it is of any signe together with the minutes of the same, and turning about euery day by the diurnall motion, doth both appeare aboue the Horizon, and also is hidden vnder the Horizon. Secondly the Equinoctiall with his equall rising and going downe, doth measure the time of the Sunne whilest he maketh his abode vnequally and diuersely aboue the Horizon. Thirdly the Horizon deuideth the one Hemispheare from the other, on which Horizon is to be considered what Angle any signe or starre maketh therewith in his ascention or descention, and according as any portion of the Ecliptique riseth or setteth rightly or obliquely, so in respect of the Angle which it maketh with the Horizon, it is called a right or oblique ascention or descention.

Why should the ascentions and descentions bee measured rather by the Equinoctiall line then by the Ecliptique, sith the course of the Sunne measureth all times?

The cause thereof is the obliquitie of the Zodiaque, hauing diuers and variable situations, whereby the Sunne abideth sometimes a great while aboue the Horizon, and sometimes but a little while, all which inequalitie is onely to bee measured by the Equinoctiall, which is alwayes equally mooued vppon his Poles. Hitherto of the Astronomicall ascention and descention in general, now of all three ascentions and descentions in particular.

Of

Of the right, oblique and meane ascention in particular, and of the chiefest causes of such diuersitie of ascentions.

Cap. 32.

AND for the better vnderstanding of the Astronomicall ascention and descention, wee wil make this diuisiō, for either it is of some point or Starre, or else of some portion of a Circle chiefly of the Ecliptique line. In the ascention of any point or starre, we consider two things. First what angle it maketh with the Horizon either right or oblique. Secondly the time from the rising of the first minute of Aries, which is the first beginning of the Longitude of any star or Circle in heauen, and in respect of the Angle euery ascention is said to be right in a right Spheare, and oblique in an oblique Spheare: Againe the time of the ascention is to be measured by the degrees of the Equinoctiall from the first minute of Aries, vnto that degree and minute of the Equinoctiall which ascendeth together with the stars, And note by the way that 15. degrees of the Equinoctial do make an houre, and foure doe make one degree of the Equinoctiall, for foure times 15. do make 60. minutes, which is an houre. Againe euery ascention considered, according to the tyme of his gate, is either right, oblique, or meane: if it be right, it is slow: if it bee oblique, it is quicke: if it be meane, it is equall. Now the ascention of any Arke or portion of a Circle is also either right, oblique, or meane: if it be right, it ascendeth slowely: if oblique, it ascendeth quickely: if meane, it ascendeth equally: And the better to vnderstand all these three kindes of ascentions, I will set downe these twelue rules here following, whereof fiue doe belong to the right Spheare, and seuen to the oblique.

In the right Spheare all the foure quarters rising from the foure principall points, haue a meane ascention, and so hath all the foure points themselues.

In the right Spheare all those signes that bee equally distant from the foure principall points haue equall ascentions.

In

3 In the right Spheare all starres or pointes that be in the Solsticiall Colure haue meane ascention.

4 In the right Spheare those signes that do ascend rightly, doe descend rightly, and those that doe ascend obliquely, doe descend obliquely.

5 In the right Spheare, Gemini, Cancer, Sagittarius, and Capricornus, doe ascende rightly, and all the rest obliquely.

6 In the oblique Spheare, the two Equinoctiall pointes haue meane ascention.

7 In the oblique Spheare eche halfe of the Spheare, beginning at either of the Equinoxes haue meane ascention: but this rule holdeth not, if that you beginne any other where.

8 In the oblique Spheare, those signes that doe ascend rightly, do descend obliquely, and those which ascend obliquely doe descende rightly.

9 In the oblique Spheare, the ascention of any supposed signe is equall to the descention of his oppolite signe, and the descention of any supposed signe, is equall to the ascention of his oppolite signe.

10 In the oblique Spheare, the ascention of any signe being added to his descention, is equall to the ascention and descention of the same signe being in the right Spheare.

11 In the oblique Spheare euery two signes equally distant from the two pointes of the Equinoctiall, haue equall ascentions and descentions.

12 In the oblique Sphere vnder the pole Arctique, al signes frem Cancer to Capricorne, do ascend rightly, and al the rest obliquely, but contrariwise vnder the Pole Antarctique.

What is the chiefe cause of the diuersitie of ascentions and descentions, as well in the right as in the oblique Spheare?

The chiefe cause is the diuersitie of the Angles which the Zodiaque maketh with the Horizon, for the sharper that the Angles be the lesser portion of the Equinoctiall riseth together with the Ecliptique, and the righter that the Angles be, the greater portion of the Equinoctial riseth, but the Equinoctiall by reason of his vniformitie, maketh his Angles alwayes equall one to another, that is to say, in the right Spheare, it maketh right Angles, and in the oblique Spheare, though not right, yet in euerye signe it maketh like Angles.

How

How to know the diuersities of the ascentions and descentions, as well in the right as oblique Spheare

Chap. 33.

THat is to bee knowne most exactly by the Tables of ascentions calculated of purpose by Iohannes de Monte Regio, and by Reinholdus called in Latine Tabulæ directionum, and you may knowe it also without hauing respect to euery minute by marking and obseruing the same in a materiall Spheare or Globe, that hath a standing foote with a firme Horizon, for if you will know the diuersities of ascentions in a right Spheare, then you must laye the Spheare or Globe so as the Horizon may passe through both the Poles, and in turning about with your hand the Equinoctiall, together with the Ecliptique from East to West, marke with what degrée of the Equinoctiall any signe beginneth to ascend, & marke that degrée of the Equinoctiall with a little péece of ware, then turne the Globe or Spheare towardes the West, vntill the last degrée of the sayd signe doe appeare iust with the vpper edge of the Horizon, and then marke what degrée of the Equinoctiall is answerable to the said last degrée of the foresaid signe, and there set another péece of ware, then count the degrées of the Equinoctiall contained betwixt those two markes, and if it bee more then 30. that signe is said to ascend rightly, if it be lesse then 30. then that signe ascendeth obliquely, if it be iust 30. then it hath a meane ascention, & by allowing 15. degrées of the Equinoctial to an houre, and 4'. to a degrée, you shall know in what time that signe ryseth. As for example if you would know what ascention the whole signe Taurus hath in a right Spheare, and also in what time it ryseth, doe thus, First lay both the Poles of the Spheare iust vppon the Horizon, so as the same Horizon may passe through both ỹ poles, then bring the first point of Taurus to the East part of the Horizon, so as it may touch the vpper brimme or edge of the Horizon, and staying it there with your hande, looke what degrée of the Equinoctiall doth also touch the Horizon at that instant, which you shall finde to bee 27. degrées 54. and marke that degree of the Equinoctiall with a little peece of ware, or some other thing that

that may be easily put out or taken away, that done, put forward the foresaid signe Taurus still towardes the West, vntill the last degrée of the saide signe bee ascended vp euen to the vpper edge of the Horizon, and there staying it with your hande, looke againe what degrée of the Equinoctiall doth rise withall, which you shall find to be 57. degrées 4′8. and there set another marke vppon the Equinoctiall, then by telling the degrées contained in the Equinoctiall betwixt the two markes, you shall finde the number of degrées to bee 29. degrées 5′4. and by allowing 15. degrées to one houre, and 4′. to a degrée, you shall find that the whole signe Taurus spendeth in his rising one houre, 5′9. 3″6. But now sith the Meridian in any place (as hath béene saide before) doth alwayes shew the right ascention of any Starre, signe, arke, or point, because that cutteth both the Equinoctiall and the Horizon with right Angles: you may therefore finde the right ascention of the sayde signe, or of any other signe or starre without remouing the Spheare from your owne eleuation or Latitude in this manner following, bring the first degrée of Taurus close to the moueable Meridian, and there staying it marke what degrée of the Equinoctiall the Meridian cutteth at that present, which you shall find to be 27. degrées 5′4. which is the right ascention of the first point of Taurus, then hauing brought the last point of Taurus to the foresaide Meridian, marke what degrée of the Equinoctiall the sayde Meridian cutteth at that present, and you shall find it to be the 57. degrées 4′8. now by counting vpon the Equinoctiall, the degrées contained betwixt those two markes, you shall finde the number to be 29. degrées 5′4. and you may find the selfe same number by subtracting the right ascention of the first point of Taurus, out of the right ascention of the last point of Taurus and thereby you shall know the time of his rising to bee the same that you found in the right Spheare. Now if you woulde knowe the ascention of any signe in an oblique Spheare, then hauing placed your Spheare according to your Latitude, which for example sake suppose to be 52. degrées, and that in such Latitude you would know what ascention the whole signe Taurus hath, and in what time hee ryseth you must first bring the first degrée of Taurus to the East part of the Horizon, so as it may méete euen with the vpper edge of the Horizon, and there staying it, marke what degrée of the Equinoctiall

tiall riseth therewith, which you shall finde to bee 12. degrées 4′8. and hauing marked that degrée, put forwarde the foresaide signe Taurus towards the West vntill the last degrée thereof be ascended vp to the vpper edge of the Horizon, and then make another marke vpon the point of the Equinoctiall, which riseth at that instant with the last degrée of Taurus, which you shall finde to be 29. degrées 4′2. and by counting the degrées contained in the Equinoctiall betwixt the two markes, or by taking the lesser ascention out of the greater, you shall find the number of degrées to be 16. & 5′4. whereby you may conclude that the ascention of Taurus in that Latitude is oblique, and that hee spendeth in his rising one whole houre 7′,3″6. And look what order is here taught to find out the ascention of any signe, the same order is to be obserued for the finding out of the descention of any signe, sauing that you must séeke for the descention of any signe in the West part of the Horizon of the Spheare of the Globe, and not in the East part. As for example, if you would know what descention Taurus hath, & in what time he descendeth in the foresaide Latitude, heere hauing brought the first degrée of Taurus to the West part of the Horizon, so as it may touch the vpper edge thereof, and hauing also marked what point or degrée of the Equinoctiall toucheth the same Horizon at that instant, which you shall finde to bee 42. degrées 3′0. cease not to turne the Spheare or Globe, vntill all the whole signe of Taurus be descended vnder the Horizon, and that the last degrée thereof doe méete iust with the vpper edge of the Horizon, and there stay it vntill you haue againe marked that point of the Equinoctiall which toucheth the Horizon at that instant, which you shall finde to be 84 degrées 5′4. and by counting the degrées contayned betwixt the two markes on the Equinoctiall, you shall find the number of degrées to be 42. degrées 2′4. so as you may conclude that the descention of Taurus in that Latitude is right, and that he spendeth in his going downe two houres 4′3.

How shall I knowe the right or oblique ascention of anye of the fixed starres, and also at what houre of the day or night they rise and set, and how long they abide aboue the Horizon: finally when they are at the highest, and when they are at the lowest, called the depression or lowest Meridian Altitude of the starres?

All

All these things are most truely knowne by Tables calculated of purpose, and also they are to be knowne by helpe of the celestial Globe in such manner as shal be declared hereafter when we come to treate of the said Globe.

Of the ascentionall difference and vses thereof.

Chap. 34.

WHat is the ascentionall difference?

It is a portion of the Equinoctiall, whereby is knowne how much the right ascention and oblique ascention of any starre, or portion of the Ecliptique line, or any other point in the firmament, doth differ one from another, As for example in that place where the Pole is eleuated 52. degrées, the right ascention of the first poinct of Taurus is 27. degrees and 54. and the oblique ascention of the same point is 12. degrées 48. here by taking the lesser out of the greater, that is 12. degrées 48. out of 27. degrées and 54. there will remaine 15. degrées and 6′. which is the ascentionall difference.

What vses hath the ascentionall difference?

The ascentionall difference being knowne, all the oblique ascentions and descentions of the Starres are easily knowne by the Tables of directions, againe by this difference is knowne the increase and decrease of the artificiall day in euery Latitude: therefore it is called of some incrementum diei. Moreouer it sheweth the semidiurnall Arke of the artificiall daye, for in euery oblique Spheare, the artificial day is alwaies either longer or shorter then the Equinoctiall day throughout the yeare, vnlesse the Sunne bee in either of the Equinoctiall points.

How is the increase or decrease of the day to be knowne by the ascentionall difference?

That shall be declared hereafter in the 50. Chapter of this first booke, whereas wee treat of the artificiall daye and night, in the meane time we will speake somewhat of the Poeticall rising and setting of the starres.

Of

Of the Poeticall rising and setting of the starres.

Chap. 35.

DEfine what the Poeticall rising and setting is.

The Poeticall rysing is the appearing of some starre aboue the Horizon, determined by the sunne, and the Poeticall setting, is either the going downe of some Starre vnder the Horizon, or else the hiding thereof vnder the beames of the Sunne.

How manifold is the Poeticall rising and setting?

Threefold, that is, Cosmicus, Acronicus, and Heliacus, the signification of which words shall appeare vnto you by the definitions of the foresaid three kindes here following: For ortus Cosmicus, called in Latine mundanus, which is as much to say here as the worldly or morning rising, is when any starre ryseth in the morning aboue the Horizon, together with the Sunne, or rather with that point of the Ecliptique line wherein the Sunne is at that time. And the Cosmicall setting, called in Latine occasus Cosmicus, is when a starre goeth downe vnder the Horizon at such time as the Sunne riseth, so as this kind of rising and setting is wholly to be referred to the rising of the Sunne.

What is *Ortus* and *occasus Acronicus*.

Ortus Acronicus which is as much to say as the Euening or temporall rysing, is when any starre riseth aboue the Horizon in the Euening at the going downe of the sunne: And occasus Acronicus, that is to say, the Euening setting is when any starre goeth downe vnder the Horizon, together with the Sunne, and therefore this kind is alwayes to be referred to the going downe of the Sunne, and not to his rysing: And whatsoeuer signe or starre doth rise Acronicè, the same goeth downe Cosmicè, and whatsoeuer starre doth rise Cosmicè, the same goeth downe Acronicè. And generally all starres that ryse in the day time, are said to ryse Cosmicè, and all those that rise in the Euening after the Sunne set, are said to rise Acronicè.

What

What is *Ortus & occasus Heliacus*.

Ortus Heliacus, that is to say, the Solar rising, is when any star by departing from the beames of the Sun appeareth, & may be seene, which before being darkned by the sunne could not be seen, And occasus *Heliacus*, is when any starre by the nigh approaching of the Sunne ceaseth to be seene, for by reason that the Sunne by his yearely course & oblique motion of the Ecliptique, doth sometimes approch to diuers starres, and sometime by little and little retireth backe againe from the same, it falleth out that those stars to whom he approcheth, are by nigh neese of his great light, darkned and not seene, and by his departing from them, and especially when the sunne is in the East or West part of the firmament, they beginne againe to be seene. And therefore as in the other 2. kinds, the Horizon together with the rising and setting of the Sunne, are to bee considered as chiefe causes thereof, so in this last kinde the chiefe cause is to be referred to the nighnesse or farnesse of the Sun from the starre.

Where to serueth the knowledge of this threefolde Poeticall rising and setting of the starres?

It serueth chiefely to vnderstand thereby those Poets and Historiographers, which in shewing the time of any act done or to be done, doe not set downe the day of the month, but are wont to describe the time by the rysing or setting of some notable starre, which they thinke most meete for their purpose, and thereby doe greatly adorne their stile, and specially being poeticall: And because that the times wherein such starres did ryse or set, doe greatly differ in these dayes from the auncient times. Many therefore of our moderne writers, as Garceus and others, haue made diuers Tables of purpose to finde out the difference, and thereby to come to the true knowledge of the times by the auncient men described of which matter I leaue to speake, thinking it not meete to trouble young Saylers therewith, for whom I chiefely wrote this Treatise of the Spheare.

Yet some affirme that the auncient men did vse the foresaide poeticall rising and setting of certaine starres, and specially of the *Pleiades*, *Hiades*, *Orion*, *Arcturus*, *Capella*, and *Lira*, (which starres were to them best knowne) as a Kalender not onely to know thereby the difference of times, and seasons of

the

the yeare: but also by their manner of rising, setting, hiding, & appearing to prognosticate & to fore-see tempests and stormes, yea and that in these daies wee also (as some write) might doe the like, though there were neither Kalender nor Ephemerides, and in that respect the knowledge heereof seemeth most necessarie for Mariners.

All such things are to bee knowne more exactly by the Astronomicall ascention and descention, then by the Poeticall rising or setting of the starres: And you haue to vnderstand that the Starres since those dayes haue changed their places, their longitudes, and declinations, and thereby in diuerse respectes haue altered their Natures and qualities, yea and the verie signes themselues: As for example, neither Taurus, Gemini, nor Cancer, is so hoat and drie now, as in times past, neither doth Scorpio cause so much thunder now, as in times past, some againe are more or lesse cold and moyst then they haue béne heretofore, the causes whereof I leaue to the discussing of the Astrologers, and so once againe ende with this matter.

Of time, what it is, and into what parts it is deuided.

Chap. 36.

MOst men that write of the Spheare, after they haue spoken of the ascentions, doe immediatly treate of the diuersitie and inequalitie of dayes and nightes, but sith dayes, nightes, and houres, are but parts of time, like as be wéekes, monethes, and yeares, I minde here therefore first briefely to treate of time, and then of all his chiefest parts in order, for if you will be instructed at large of these matters, then reade the booke of Iohannes de sacro Bosco de anni ratione, and also Iohannes Garceus his booke de tempore.

How define you time?

Leauing to speake of time, without time, that is to saye, euerlasting and infinite, called of the Latines Eternitas, ascribed

chiefely to God, and therefore not contained within the moueable Spheares or heauens: I mind to speake here onely of that time which is a number measuring the mouing of the first moueable, and of all other mutable thinges, which time had his beginning with the world, and shall end with the same, & this time consisteth of two parts, that is first, and last, or rather before or after, successiuely following one another, and these two parts are knit together with a common bound called of the Latines Nunc, that is to say now, or at this present, which is the end of that which went before, and the beginning of that which followeth after, and therefore some doe deuide time into three parts, that is, time past, time present, & time to come, but the time present is a moment indiuisible, and is the beginning of time, euen as a point or pricke is the beginning of all Magnitudes, and yet least part thereof it selfe: Againe time is deuided of some into greater and lesser partes, the greater are such as these: Kalenders, Nones, Ides, a weeke a month, a yeare, the space of fiue yeares, called of the Romaines Lustrum, and of the Grekes Olympias, the Romaines did call it Lustrum a lustrando, that is to say, of going about, because that they vsed in the end of euery fiue yeares, with lights and torches of waxe to goe in procession round about the Cittie, and did purge the same by sacrifising a Dogge, a Sowe, and an Ore, and at that time also they did chuse their Dictator in a place called the fielde of Mars, but the space of fiue yeares called Olimpias, tooke his name of the high mount Olympus in Greece, whereas in the end of euery fiue yeares were celebrated all kinde of martiall playes, as Fencing, Wrestling, Running, and such like in the honour of Iupiter Olympicus, also the space of 15. yeares called indictio, in which space those forraine Nations that dwelt farre off, & were tributarie to the Romaine Empire, paid their tributes that is to say, in the first fiue yeares they payde onely gold, in token of their obedience to the Empire: In the second fiue yeares they paid siluer for Souldiers wages, and in the last fiue yeares they paide brasse towards the reparation of armour and munition. Item the space of an hundred yeares, called in Latine seculum, and in English an age, whereof the playes that were celebrated in Rome euery hundred yeare, were called Ludi seculares, and last of all the space of a thousand yeares, called æuum, containing ten ages, againe the

lesser

lesser parts (as Iohannes de sacro Busto saith) are these fiue, the first is called in Latine quadrans, which is the fourth part of a day that is sixe houres: The second punctus, which is the fourth part of an houre in the sunnes account, but in the Moones account the fift part of an houre: The third is called momentum, which is the tenth parte of punctus: The fourth is called vncia, which is the twelfth part of momentum: The fift is called Atomus, which is the 48. part of vncia. But because in all the greater parts of time, there is no greater variation or difference, then in that which in Latine is called annus, and in English a yeare. I mind here therefore first to treat of a yeare, and then of monethes, weekes, dayes, nights and houres.

Of the yeare, and of his diuers kinds, and of the diuers computations had thereof in diuers ages, and amongst diuers Nations.

Chap. 37.

BE there diuers kindes of differences of yeares?

Yea indeede, but I will speake here only of three kindes or differences, that is of the great yeare, the Solar yeare, and the Lunar yeare, whereof the two last are most necessarie for our purpose.

What is the great yeare?

The great yeare is a space of time in the which not onely all the Planets, but also all the fixed Starres that are in the firmament, hauing ended all their reuolutions doe returne againe to the selfe same places in the heauens, which they had at the first beginning of the world: And therefore it is called of some the yeare of the worlde, and of some the great yeare of Plato, which containeth according to Alphonsus, 49000. yeares, whereof wee haue spoken before, yet some affirme that the perfect yeare of the worlde containeth but 36000. yeares, whose reuolution is after one degree in 100. yeares, but leauing this matter as not greatly profitable, wee will speake now of the yeare Solar.

36000 the yeare of the world.

Of the sunnes yeare called in Latine *annus solaris*, and of the diuers kinds thereof, and first of the Tropicall yeare, both equall and vnequall.

Chap. 38.

WHat is the yeare Solar?

It is that space of time in which the sunne departing from any point of the Ecliptique line, or from some fixed starre of the Zodiaque, goeth round about the Zodiaque by his owne proper moouing, which is from West to East, and so returneth againe to the selfe same point or starre from which he first departed, and the Astronomers doe make diuers diuisions of the Solar yeare, for first they saye that it is either Astronomicall or Politicall: Secondly that the Astronomicall yeare is either Tropicall or Syderall. Thirdly that the Tropicall is either equall or vnequall, which vnequall yeare they otherwise call the apparant yeare, and true yeare, all which kindes haue in a manner one selfe definition, sauing that the Tropicall yeare taketh his beginning from the vernall Equinoctiall point, and the Syderall yeare from the former starre of the Rams horne, and doe differ chiefely in quantitie.

Shew then what quantitie, that is to say, how many dayes, houres, and minutes euerie such yeare containeth.

The equall Tropicall yeare being counted alwayes from the middle point of the vernall Equinore, contayneth 365. dayes, fiue houres, 4′9. 1″5. and 4‴6. But the vnequall or apparant Tropicall yeare containeth sometime more and somtime lesse then the equall yeare, for sometime besides the 365. daies and fiue houres, it amounteth to 5′6. 5″3. and 1‴. so as it is more then the equall Tropicall yeare by 7′.3″7. and 1‴5. and sometime ouer and besides the foresaid 365. daies and fiue houres, it onely containeth 4′2. 3″8. and 2‴7. which is lesse then the equall Tropicall yeare by 6′. and 3‴. which vnequalitie chiefely chanceth by reason of the vnequall precession of the two Equinoctiall points before defined in the 26. Chapter.

Of

Of the Syderall yeare, and how much it containeth.

Chap. 39.

WHat is the Syderall yeare?

The Syderall or starry yeare is that space of time wherein the Sunne walking vnder the firmament, departeth from the first or foremost starre of the Rams horne, and returning to the same starre againe, which space of time alwayes and equally contayneth 365. dayes, sixe houres, 9′. and 3″9. so as this yeare is alwaies greater then the Tropicall yeare, and by his equalitie doth alwaies rule and rectifie the inequalitie of the Tropicall yeare.

Of the Politicall yeare, and diuers kinds thereof

Chap. 40.

WHat is the Politicall yeare?

It is a yearely space of time which any people or nation attributeth to the course of the Sunne or of the Moone or of eyther of them which is diuers and manifold, according to the diuers customes of the Nations, of all which I meane not to speake at this present particularly, but of certaine speciall and necessary to bee knowne, as of the Iulian yeare, of the Egyptian yeare, of the Iewes yeare, and of the Athenian yeare.

Of the Iulian yeare and why it is so called.

Cap. 41.

WHat is the Iulian yeare?

The Iulian yeare is that which we vse at this present day which of all other yeares drawe th nigheſt vnto the Tropicall yeare, for this yeare consisteth of 365

daies and fire houres, which fire houres, if it should be reckoned euery yeare, it would make a great confusion, and therefore it is reckoned at the end of euery fourth yeare, which yeare consisteth of 366. daies, for foure times fire doth make 24. houres, which is one whole naturall day, wherof that yeare is called the leape yeare, And thereby the Iulian yeare is said to bee two fold, that is common, containing 365. daies, & the other bissextile or leape yeare, containing 366. daies. This word bissextile is deriued of bis and sextus, because the sixth day next before the Kalends of March is twice repeated or reckned, which indeede is the 25. of Februarie, vpon which day the feast of Saint Mathias commonly falleth.

Why was it called the Iulian yeare?

Because Iulius Cæsar the first Monarch of the Romaine Empire cauled the yeare (according to the course of the Sunne) to be reduced to the number of dayes and houres before expressed, who brought an excellent Astronomer with him at his comming from Egypt, as well for that purpose as to teach the Mathematicall disciplines vnto the Romaines, yet you haue to consider that the Iulian yeare being greater then the Tropicall yeare, doth cause great diuersitie in that it maketh as well the Equinoctiall and Solsticiall points, as also the entrance of the Sun into the other signes by little and little to anticipate or to runne before, for whereas in Iulius Cæsars time the vernall Equinox was the 23. day of March, the same Equinox is now about the 11. day of March which is sooner by 12. dayes.

Of the Egyptian yeare, and how many dayes it containeth.

Chap. 42.

The Egyptian yeare containeth the iust number of 365. dayes, by reason of which equalitie this yeare is very fit to serue the Astronomers turne in making their Astronomicall computations, but the Egyptian yeare hath no certaine place of beginning: For by omitting the fire houres which is in the Iulian yeare, it doth anticipate in the space of 4. yeares one

one whole day in such sort, as 1460. Julian yeares doe make of the Egyptian yeares. 1461.

Howe many Moones the Iewes yeare, and the Athenians yeare doth containe.

Chap. 43.

THe Iewes yeare contayneth for the most part twelue Moones, and sometime thirteene Moones, which kinde of yeares did agree with the yeares of the Greekes, and of the Athenians, and also of the ancient Romaines before Iulius Cæsars time: and the auncient Romaines did begin their yeare from March, but the latter Romanes from the winter Solstice. Againe the Iewes did beginne their yeare at the first new Moone that followed next after the vernall Equinox: But the Athenians began their yeare at the new Moone that followed next after the Summer Solstice: The most people of Asia began their yeare at the Autumnall Equinox: But the most part of those that dwell in these parts of the world, following the custome of the Romaine Church, doe begin their yeare at the Kalends of January, which in old time was not much distant from the Winter Solstice, which Solstice at Christs birth was the 25. of December, but now the same Solstice is about the twelfth day of December, so as the Winter Solstice falleth sooner by thirteene daies then it did at that time. But we heere in England doe begin the yeare at the 25. of March.

Of the yeare Lunar, and of the kinds thereof.

Chap. 44.

HOw many kindes of Lunar yeares be there, and which be they?

Of Lunar yeares there be two kindes, whereof the one is ordinary called in Latine Annus communis, and the other extraordinarie or excessiue, called by a Greeke name Embolismalis, The ordinary

dinary or common yeare, is the space of twelue Mones or changes, passing by course within the yeare Solar, and is called common because it hath twelue Mones Lunar, euen as the Solar yeare hath twelue monthes Solar, and consisteth of 354. dayes and a little more, so as the Solar yeare exceedeth the Lunar yeare by 11. dayes, for the yeare Solar containeth (as hath beene saide before) 365. dayes, in which account the Fractions in both yeares are omitted: And therefore if these two yeares should begin together at one selfe time, the Lunar yeare would end his course sooner by 11. dayes then the yeare Solar.

What is the extraordinarie Lunar yeare called Embolismalis?

It is the space of thirteene Mones or changes containing 384 dayes, so as this yeare exceedeth the common Lunar yeare by 30. dayes, and is more then the yeare Solar by 19. daies.

Of the diuers kinds of monthes, and into what parts euery Solar moneth is deuided according to the Romanes, that is, into Kalends, Nones, and Ides.

Chap. 45.

HOw many kindes of monethes be there, and which be they?

There be three kinds, that is, the month Solar the moneth Lunar, and the moneth Vsuall.

The month Solar is that space of time which the sun spendeth in passing through any one of the 12. signes.

The Lunar month is that space of time which the Mone spendeth while she departing from the Sun returneth to him againe.

The vsuall month is that number of daies which are set downe in our common Kalenders, whereof some containe thirtie dayes, some thirtie and one, and the moneth of Februarie hath but 28. dayes. But if you will readily know which containe more dayes and which lesse, keepe alwaies in memorie these old English verses here following.

Thirtie

Thirtie dayes hath Nouember,
Aprill, Iune, and September:
Februarie hath 28. alone,
And all the rest hath thirtie and one.

But when it is leape yeare, Februarie hath 29. daies, Againe the Romaines deuided the Solar moneth into Kalends, Nones, and Ides.

What be Kalends?

The Kalends are the first day of euery moneth from which the Romaines counted the daies of the moneth proceeding backward, As for example, the first day of Aprill they named the Kalends of Aprill, and the last day of March next before they called in Latine pridie Kalendas Aprilis, that is the daye before the Kalends of Aprill, and the next day before that, the third Kalends of Aprill, and the next day before that the fourth Kalends, and so forth vntill they come to the Ides.

Whereof sprang this name Kalends?

Of the Greeke verbe Calo, which is as much to say as call, for the first day of euery month ꝑ cryer standing in a high place made foure cals or more to signifie thereby to the people howe manye dayes in that moneth the Faires or Markets called Nundinæ should endure, and of Nundinæ sprang this word Nonæ, that is to say the dayes of the faires: For loke howe many Nones there were in euery moneth, so many faires there were, during which time the Romaines neuer worshipped any God because there was no holy day during that time, and therefore Ouid sayth that Nonarum tutela Deo caret, that is to say, no God had tuition of the Nones.

What are Ides?

They are those dayes by which the Nones are deuided from the rest, and these Ides doe deuide in a manner the whole moneth into two equall parts, for the first Ides most commonly falleth either on the 13. 14. or 15. day of the moneth.

How many Ides, Nones, and Kalends doe belong to euery moneth?

Of Ides euery month hath eight, but of Nones, March, May, July, and October, haue sixe and all the rest of the moneths haue

but

but foure Nones, but they differ most in the number of Kalends, as you may perceiue by this Table following, which sheweth how many Kalendes, Ides, and Nones, doe belong to euery moneth. Thus farre of the moneth Solar, now I will speake of the month Lunar.

The Table.

Moneths.	Kal.	Ide.	None.	Moneths.	Kal.	Ides.	None.
Ianuarie.	19	8	4	Iuly.	17	8	6
Februarie.	16	8	4	Auguſt.	19	8	4
March.	17	8	6	September	18	8	4
Aprill.	18	8	4	October.	17	8	6
May.	17	8	6	Nouember	18	8	4
Iune.	18	8	4	December	19	8	4

Of the diuers kindes of moneths Lunar.

Chap. 46.

HOw many kindes be there, and which be they?

Iohannes de Sacro Buſto ſayth, that there bee foure kindes, that is the moneth of paragration, the moneth of Apparition, the moneth medicinall, and the moneth of conſecution.

The month of Paragration, is that ſpace of time in which the Moone departing from any one point of the Zodiaque, goeth by her proper moouing about the Zodiaque, and returneth againe to the ſaide point from which ſhe firſt departed, which her reuolution is accompliſhed in 27. daies and 8. houres. And this reuolution of ſome is called a yeare, and by this account the Moone tarrieth in euery ſigne two daies fiue houres and 2′9.

The moneth of Apparition conſiſteth of 28. dayes, deuided commonly by foure weekes, euery weeke containing ſeuen dayes, for foure times ſeuen maketh 28. of which foure weekes the firſt

is

is counted from her first apparance vnto the ende of the seuenth day, and so forth from weeke to weeke, so as the fourth weeke endeth at the 28. day, in which account the odde houres during the Moones abode vnder the beames of the Sunne, when as she is said to be combuste, are not reckned.

The moneth Medicinall containeth but 26. dayes, and a halfe (as Galen saith) and is deuided also into foure weekes, the diuision being made by minutes.

The moneth of Consecution is that space of time wherein the Moone being in coniunction with the Sunne, goeth about her Circle and returneth againe to the same point, and not finding the Sunne there because he hath in that while passed through one whole signe, she hasteth after and in two dayes and foure houres 44 and a little more she ouertaketh the Sunne, and is againe with him in coniunction, of which her following and ouertaking the Sunne, this moneth is called the moneth of Consecution, which moneth consisteth of 29. dayes and a halfe: during which time as the Sun by his owne proper course passeth through one signe or there abouts, so the Moone by her course in the selfe same time passeth through the whole Zodiaque and one signe more: And note by the way that the Sunne in making his owne proper course doth not enter into any signe in the very beginning of any moneth, but rather about the midst of euery moneth, or at the least not much ouer or vnder that day.

Of a Weeke.

Cap. 47.

NOw because that euery month as well Solar as Lunar is deuided into foure weekes, I will speake somewhat of a weeke.

What is a weeke?

A weeke called most commonly in Latine Septimana, which is as much to saye as seuen mornings, is the space of seuen dayes, whereof the first is called Sunday, the second Munday and so forth to Saturday

turday, which names the Gentiles gaue to these seuen dayes in honour of the seuen Planets whom they worshipped as Gods, for they called the first day the day of the Sunne, the second the day of the Moone, the third the day of Mars, the fourth the day of Mercury, the fifth the day of Iupiter, the sixth the day of Venus, the seuenth the day of Saturne.

Are there any more names belonging to this word weeke?

Yea, it is called also by a Greeke name *Hebdoma*, that is to say containing seuen dayes, and in the scripture it is called sometime Sabbatum, as when the Pharisie sayd that he fasted Bis in Sabbato that is to say, twice a weeke, for the Iewes called Sunday the first of the Sabaoth, and Munday the second of the Sabaoth, and so forth in order vntill Saturday, which in deede was their true Sabaoth or day of rest.

Why is it not still so counted amongst vs Christians, but changed into Sunday?

For two causes, first to auoide the superstition of the Iewes, and partly it was done in the honour of Christ, whose day of birth, resurrection, and sending of the holy Ghost, was on the Sunday.

Of dayes and nights both naturall and artificiall.

Cap. 48.

THe Astronomers doe deuide the dayes into two kindes, whereof the one is called naturall, and the other artificiall.

Which call you a naturall day?

A naturall day is one entire reuolution of the Equinoctiall aboue the earth, whereunto must be added such portion of the Zodiaque, as the Sunne in the meane while maketh by his proper motion, which is from West to East.

In what time doth the Equinoctiall euery day make his reuolution?

In 24. houres, which space containeth both day and night, according to which reuolution and number of houres, the most part of Horologies or clockes in the East countryes doe goe, and are set to shew the houres of the day, but yet diuersly, for some begin

their

their naturall day at the rysing of the Sunne as the Bohemians, and the Persians, and some at the going downe of the Sunne, as the Italians, the Athenians, the Iewes, the Egyptians, and the Arabians, but the Astronomers reckon their naturall daye from noonetide to noonetide.

If the Equinoctiall doth make his reuolution iust in 24. houres, then all naturall daies are equall.

That is true if ye onely consider the motion of the Equinoctial, but if you adde thereunto (as I said before) that portion which the Sunne in the meane while maketh by his owne proper motion, you shal find them to be vnequall, because that portion is sometime more, sometime lesse, according to the swift or slow ascention of the signe wherein the Sunne is.

What is the artificiall day?

It is the distance or space that is betwixt the rising of the Sun, and going downe of the same.

The causes why the time betwixt the rising and going downe of the Sunne is vnequall.

Cap. 49.

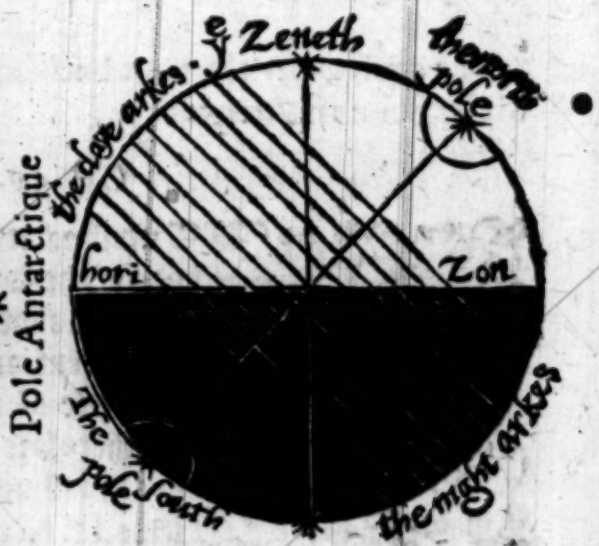
IT must needes bee vnequall, because the aboue of the Sun aboue the Horizon is variable, as well for the vnequall ascention and descention of the signes, as also for the obliquitie of the Horizon and Zodiaque: and therefore the spaces of the artificiall dayes must needes be vnequall: for the Sun as well in ascending from the beginning of Capricorne, to the beginning of Cancer, as also in descending from the beginning of Cancer to the beginning of Capricorne, describeth on eth part 182. Circles or Paralels, the middlemost whereof is the Equinoctiall. All which Paralels are deuided into two parts by the Horizon, and the Arkes which are aboue the Horizon are called the artificiall daies, and the Arkes beneath the Horizon are called the artificiall nightes, which Arkes to those that dwell vnder the Equinoctial in a right Spheare are alwaies equall, that is to say, the diurnall Arke is equall to the nocturnal, because

because their Horizon passeth through the Poles of the world, but to those that dwell in an oblique Spheare, aboue whose Horizon the Pole is any thing eleuated, bee it neuer so little, the Arkes or Paralels are vnequal one to another, that is to say, either making short daies and long nights, or else long daies and short nights, the Equinoctiall only excepted, which as well in the oblique Spheare as in the right, is alwaies deuided by the Horizon into two equal partes, and so maketh the dayes and nights equall in all places of the world. All which thinges you shall easily comprehend by these two figures following, whereof that on the left hand representeth the right Spheare, and the other on the right hand representeth the oblique Spheare.

A figure of the right Spheare.



A figure of the oblique Spheare.



And here I thinke it not amisse to shewe you howe to finde out the length of euerie artificiall day and night throughout the yeare in euerie Latitude by the materiall Spheare, and likewise howe to know at what part of the Horizon the Sunne riseth and setteth euerie day, and also how to find out his Meridian Altitude, whereby you shall know how nigh or how farre from your Zenith he is euerie day.

How

How to find out by the materiall Spheare or Globe, and by help of the ascentionall difference before defined, the increase and decrease of euery day throughout the yeare in euery seuerall Latitude, and at what houre the Sunne riseth and setteth.

Cap. 50.

FIrst hauing set the Sphear at your Latitude, learne to know by some Table or instrument in what signe and degrée thereof the Sunne is at such day of the moneth and yeare as you séeke, and bring that degrée close to the mouable meridian, & there marke in what point or degrée the said Meridian cutteth the Equinoctiall, and what number it hath, for so shall you haue the right ascention of the degrée of the Sunne for that day. That done, bring the said degrée of the Sunne to the East part of the Horizon, so as it may méete euen with the vpper edge thereof, and staying it there, marke what degrée of the Equinoctiall at that instant doth also touch the Horizon, and what number it hath, and that is the oblique ascention of the foresaid degrée of the Sunne, then subtract the lesser number out of the greater, and that which remaineth shal be the ascentionall difference, as for example in this present yeare 1590. the xi. day of Aprill the Sunne is in the first degrée of Taurus, whose right ascention in the Latitude 52. by doing as before is taught, you shall find to be 27. degrées and 54. and the oblique ascention thereof to be 12. degrées 48. and the ascentionall difference to be 15. degrées 6′. which difference you must first double, and then conuert the same into houres and minutes by allowing 15. degrées to an houre, and 4′. to a degrée, that done, adde those houres and minutes to the Equinoctiall day, which is alwaies 12. houres, and the summe of that addition will shew you the length of the day, when the sunne is in the first point of Taurus, which is 14. houres and 12. and that is the true length of that day. But you haue to note by ẏ way that as you haue to adde the sum of ẏ houres to the Equinoctiall day the Sun being in any of the 6. Northerne signes, so must you subtract the said houres from the Equinoctiall day, the Sunne being in any of the sixe Southerne signes, As for example, suppose the Sunne to be in the first point of Scorpio,

the

the right ascention whereof is 207. degrées 54. and the oblique ascention is 223. degrées, here by taking the lesser out of the greater you shall find the ascentionall difference to bee 15. degrées 6′. which being doubled, maketh 30 degrées and 1′2. that is two houres and 1′2. which if you subtract from 12. there will remaine 9. houres 48. which is the length of the artificiall day, when the Sunne is in the first degree of Scorpio, the one halfe whereof is called the semi-diurnall Arke of that artificial day, which is 4. houres 54. minutes, whereby you may gather that the Sun at that time riseth foure minutes after seuen of the clocke, and setteth againe foure minutes before fiue. so likewise in the former example where the ascentionall difference was 15. degrées fiue minutes, which being doubled made 30. degrées and 1′2. that was two houres and 1′2. which being added to 12. houres made 14. houres and 1′2. the halfe whereof is seuen houres and fiue minutes, whereby you may gather that the Sunne did then rise 6′. before 5. of the clocke in the morning, and did set 6′. after 7. of the clocke in the Euening, and so you haue both the forenoone & afternoone of the day, which two times are best to bee reckoned alwayes from 12. a clocke at noone, that is to say, the forenoone houres and minutes from twelue backwarde, and the afternoone houres and minutes from twelue forward, and by subtracting the whole length of the artificiall day from 24. houres, you shall haue the length of the artificiall night, as in the former example take 14. houres and 1′2. from 24. houres, and there will remaine for the length of the artificiall night nine houres and 4′8.

How to know by the materiall Spheare or Globe, in what part of the Horizon the Sunne riseth and setteth euery daye, and thereby the length of the day. Also how to know the Meridian altitude of the Sunne euery day throughout the yeare, and being at his Meridian altitude, to know how farre distant he is from the Zenith euery day.

Cap. 51.

FIrst then hauing set the Spheare or Globe at your Latitude, which suppose to be 52. degrées, bring the degrée of the Sun for that day, to the East part of the Horizon, so as it may méete iust with the vpper edge thereof, and there

there set a little peece of ware vpon the Horizon, that done turne the said degree of the Sunne to the West part of the Horizon vntill it meete againe with the vpper edge of the Horizon, and there set another peece of ware vpon the Horizon, and those two markes will shewe you in what part of the Horizon the Sunne riseth and setteth: As for example, I would know this present yeare 1594. in what part of the Horizon the sunne doth rise and set the twelfth of June, here finding by the Ephemerides that the Sun is entred 16. into Cancer at that day, I bring that point of the Ecliptique to the East part of the Horizon, so as it may meete iust with the vpper edge thereof, and there I set a little peece of ware vpon the Horizon: that done I turne the said point of the Ecliptique to the West part of the Horizon, and whereas that point toucheth the vpper edge of the said Horizon, I set there another peece of ware vpon the Horizon, then counting the degrees vppon the Horizon from the true East point thereof to the first peece of ware Northward, I finde the number of degrees to bee 40. degrees or thereabouts, which containeth three pointes and a halfe and somewhat more, of the Mariners Compasse, whereby I gather that the Sun riseth at that time very neere to the Northeast, and setteth neere to the Northwest, because the number of the degrees in both parts of the Horizon are like.

How shall I know how many points of the Mariners Compasse are contained in any number of degrees, exceeding the number of degrees and minutes contained in one point?

The Mariners Compasse contayneth 32. points, and euerye peint containeth 11. degrees and $\frac{1}{4}$ of a degree which is 15. minutes, wherefore whensoeuer you would know how many points of the compasse are contained in any number of degrees be it great or small, multiply that number by foure, and deuide the product therof by 45. and the quotient will shew the number of the points, and if ther be any remainder, then because the Mariner doth make euery point to haue foure quarters, multiply that remainder by foure, and deuide the product by 45. which is the common Diuisor, and the quotient will shew the quarters, or if the remainder be but small, then multiply that remainder by eight, which are halfe quarters, and deuide the product thereof by 45. as before, and the quotient will shew the halfe quarters of a point: As in the former

example in multiplying 40. degr. by 4. the product is 160. which if you deuide by 45. you shall find in the quotient 3. whole pointes, and the remainder to be 25. which being multiplyed by 4. the product will bee 100. which if you deuide by 45. you shall finde in the quotient 2. quarters of a point, & the remainder to be $\frac{10}{45}$ of a quarter, that is to say, if you can deuide one quarter in 45. parts, then you must take 10. of those parts, & adde them to the former summ, which being of small importance is not to be regarded. But now to returne to my first matter, I saye that by counting the degrées vpon the Horizon, from the first péce of ware to the South point of the Horizon, I find the number of degrées to be 130. degrées, & by allowing 15. degr. to an houre, I find the halfe day to containe 8. houres 1′0. which being doubled maketh 16. houres 2′0. Then to know the Meridian altitude of the Sun, you must bring the degrée of the sunne right vnder the Meridian, and the number of the degrées contained in the Meridian betwixt the South point of the Horizon, and the said degrée of the Sun wil shew the Meridian Altitude of the Sunne, so shall you finde the Meridian Altitude of the sun, being in the first point of Cancer to be 61. degrées, which once had, the distance frō the Zenith is soone knowne: for if you subtract 61. degrées from 90. you shall find the distance of the Sunne from the Zenith to bee 29. degrées. Againe contrariwise the distance from the Zenith being subtracted from 90. the remainder will shew the Meridian Altitude, for those two numbers being added together, doe alwayes make a iust quarter of the great Circle, which is 90. degrées.

Of houres as well equall as vnequall, and into what partes they are deuided.

Chap. 52.

AS of dayes and nights there be two kinds, that is naturall and artificial before defined, so likewise are there 2. sorts of houres, that is equall, and vnequall: An equall houre is the 24. part of a naturall day, and euery such houre containeth 15. degrées of the Equinoctiall, for 15. times 24. maketh 360. degrées, which is the whole

whole circuit or Longitude of the Equinoctiall, which according to the diurnall moouing of the first moueable maketh his reuolution in 24. houres as hath beene said before, and therefore this equall houre is also called an Equinoctial or natural houre. The vnequal houre is the twelfth part of an artificiall day or artificiall night, which daies and nights as they be sometimes long and somtimes short, according to the time of the yeare, so are the houres of the same. For both day and night, be it neuer so short, is deuided by the Astronomers into twelue houres, so as when here in some part of England towards the North the artificial day is 17 houres long, and the night but seuen houres, if you deuide either of these into twelue parts, you shall find that euery such twelfth part of the day shall containe more then the naturall or Equinoctiall houre by 2′ 5 and the twelfth part of the said artificiall night to containe but the one halfe of an equall houre and fiue minutes, which notwithstanding being both added together, will make in all 24. equal houres, which is a naturall day, so as by this meanes you may easily perceiue that a naturall day comprehendeth both kinds of houres, as well vnequall as equall. Note also that the vnequall houres are called sometime artificiall and sometime temporall houres, artificiall, because they are dayly changed by the varietie of the artificiall dayes and nights, and are neuer equal but twice in the yeare, when the Sunne is in either of the Equinoxes: and they are called temporall, because the auncient obseruers of time were woont to make diuers clockes and Horologies to shewe these vnequall and temporall houres, of which clockes there are yet some to be seene at this day. Moreouer the houres both equall and vnequall are deuided not onely into quarters of houres, but also into minutes, for euery houre bee it long or short, is deuided into 60. minutes, and euery minute into 60. seconds, and euery second into 60 thirdes, and so forth to fourths, fifts, sixthes, and into as many as you wil, so as you make your diuision alwayes by 60. But you haue to note, that as the Astronomers doe deuide the artificiall daye and artificiall night into houres both equall and vnequall, so the Iewes doe deuide ech of them into foure quarters, in manner and forme following.

How and in what manner the Iewes doe deuide the artificiall day and night, ech of them into foure quarters.

Chap. 53.

THey deuide the Artificial day into foure quarters by allowing to euery quarter 3 houres, accounting the first houre of the first quarter at the rysing of the Sunne, and the third houre of the said quarter they called the third houre, and the third houre of the second quarter they called the sixth houre, which was midday or nonetide, againe they called the third houre of the third quarter, the ninth houre, and they called the second houre of the fourth quarter the eleuenth houre, and they called the last houre which was the twelfth houre of the day, euentide because then the sunne went downe.

Whereto serueth the knowledge hereof?

By knowing this account you may the better vnderstande certaine places of the Scripture making mention of thinges done at certaine houres not like vnto our common houres. For whereas it is saide in the Gospell of Saint Iohn, that Christ healed the Rulers sonne that was sicke of an Ague in Capernaum, and that the Ague left him the seuenth houre, is as much to say, as the Ague left him at one of the clocke in the afternoone: Againe whereas mention is made in the Gospell of S. Matthew, of the labourers that came to worke in the Vineyard at the eleuenth houre is to bee vnderstoode at fiue of the clocke in the afternoone, or rather one houre before the sunne set, for you must thinke that the Sunne ryseth not nor yet goeth downe in Iewrie alwayes at fiue of the clocke, for then they should haue no artificiall day nor night, but all dayes and nightes should bee a like. Also they deuided the artificiall night into foure quarters, otherwise called by them the foure watches of the night, for the first three houres was the first watch, during which time all the Souldiers both young and olde of anie fortified Towne were wont to watch, the second three houres they called the second watch, which was about the dead of the night, at which time the young Souldiers onely watched, and the third

quarter

quarter of the night containing also three houres, and was called the third watch the Souldiers of middle age did watch, and the last three houres called the 4. watch which was about the breake of day, the old Souldiers onely watched. But now because the auncient Astronomers do appoint the gouernment of ỳ vnequall houres to the seuen Planets, it shall not bee amisse to shew you heere what Planet raigneth euery houre both day and night.

How to knowe what Planet raigneth in euery houre of the day or night artificiall, as well by helpe of a Table, as by a rule contained in one verse.

Cap. 54.

BVt first I wil describe vnto you the Table, and then briefly set downe the vse thereof. In the first collum of this Table on the left hand are set downe the seuen dayes of the weeke, whereof the first is Sunday, and the second Munday, and so forth downeward to Saturday, against euery which day the Planets are placed towardes the right hand, euery one in course one after another, & in the first row of this Table which is the head or front thereof, are placed the houres of the day written in Arithmeticall figures, & in the next row of the said front, are set downe ỳ houres of the night written as you see in common numerall letters.

The Table,

Houres of the day	I	2	3	4	5	6	7	8	9	10	11	12		
Houres of the night.	III	IIII	V	VI	VII	VIII	IX	X	XI	XII			I	II
Sunda.	☉	♀	☿	☽	♄	♃	♂	☉	♀	☿	☽	♄	♃	♂
Mund.	☽	♄	♃	♂	☉	♀	☿	☽	♄	♃	♂	☉	♀	☿
Tweid.	♂	☉	♀	☿	☽	♄	♃	♂	☉	♀	☿	☽	♄	♃
Wedn.	☿	☽	♄	♃	♂	☉	♀	☿	☽	♄	♃	♂	☉	♀
Thursd.	♃	♂	☉	♀	☿	☽	♄	♃	♂	☉	♀	☿	☽	♄
Friday.	♀	☿	☽	♄	♃	♂	☉	♀	☿	☽	♄	♃	♂	☉
Saturd.	♄	♃	♂	☉	♀	☿	☽	♄	♃	♂	☉	♀	☿	☽

The vse of the Table.

Now the vse of the said Table is thus: whensoeuer you would know in what houre of the day or night any Planet raigneth, you must first seeke out the houre of the day or night, and if it bee of the day, then you shall find it in the first row of the front, if of the night, in the second row of the front, as hath beene said before: & from that houre descende with your finger to the common Angle standing right against the day which you seeke, and that will shew you what Planet thē raigneth. As for example, if you would know on Wednesday at 8. of the clocke of the day what Planet raigneth, then hauing found the number of 8. in the front, written in Arithmeticall figure, come straight downe from thence with your finger to the common Angle standing right against Wednesday, and you shall find that Mercurie raigneth. And if you would know what Planet raigneth the same day at the eight houre of the night, then descend from the houre of the night downe to the common Angle, and you shall find that the Sunne raigneth, and so forth of all the rest.

The rule contained in one verse, and the vse thereof.

The rule in verse is thus:

Sol, Ve, Mer, Luna, Saturnus, Iupiter, & Mars.

These vii. words (the coniunction & being left out) doe signifie the seuen Planets: For Sol is the Sunne, Ve standeth for Venus, Mer for Mercurius, Luna is the Moone, and the other three Planets following, as Saturnus, Iupiter, and Mars, doe make vp the number of seuen, which must alwaies follow one another, in such order as they are here set downe in the foresaid verse, and to haue the true vse of this rule, you must first apply euery Planet to his owne proper day, as Sol to Sunday, Luna to Munday, Mars to Tuesday, Mercurius to Wednesday, Iupiter to Thursday, Venus to Friday, and Saturnus to Saturday: for euery one of these Planets gouerneth the first houre of his owne proper day, and the Planet placed next to him in the verse, gouerneth the second houre of the same day, and so forth orderly, as for example, if you would know what Planet shall raigne on Sunday at the third houre of the day, you must first say that Sol doth raigne the first houre be-

cause

cause that is his day, and Venus raigneth the second houre, and Mercurie the third houre according to your rule, and so by képing the order of the verse, you shall easily appoint to euery houre both of the day and of the night artificiall his owne gouernour: For though both day and night be deuided ech of them into 12. houres, making in all 24. houres, and that there be but seuen Planets, yet by appointing euery Planet to his own proper day as gouernour of the first houre of the same day, and by obseruing the order of the verse in repeating the said Planets, you shall not faile to giue to euery houre his proper Planet. Thus hauing sufficiently spoken of the celestial part, I will now procéde to the Elemental part of the world, contained in the second Booke of this Treatise.

The second part of the Spheare.

Of the Elementall part of the world.

Cap. 1.

WHat doth the Elementall part containe? I told you before that as the celestial part doth cõtaine the eleuen heauens before described, so the elemental part containeth the 4. Elements, that is to say, fire, Aire, Water, & Earth, which are of themselues pure substances, and the first and next beginnings whereof all mixt bodies are compounded, & therfore not to be sæne with our outward eyes, for as we our selues are bodies compound, so with our outward senses we can discerne nothing but that which is compound: and therefore the fire, aire, water or earth which wee dayly fæle or sæ, are not the Elements themselues, but things compounded of them. The natures & properties of which Elements I mind here but briefely to touch, sith the exact handling thereof belongeth rather to naturall Philosophers and to Physitians, then to Geographers, who haue to deale only with the situations of ỹ earth with Zones, Paralels, Climes, Longitudes, Latitudes, distances and such like things belonging to the measure & description of this earth here which we inhabite.

Define these Elements.

Of the Fire and of his nature and motion.

Chap. 2.

THe Fire is an Element most hoat and dry, pure, subtill, and so cleare as it doth not hinder our sight looking through the same towards the stars, and is placed next to the Spheare of the Moone, vnder the which it is turned about like a celestiall Spheare.

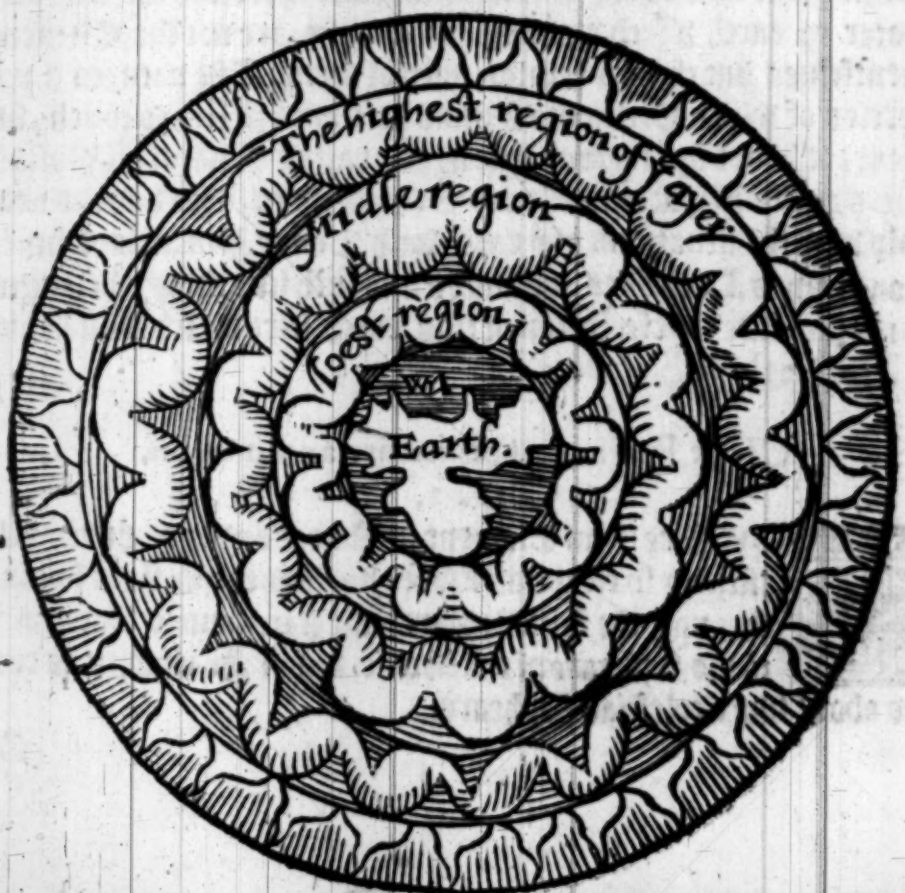
Of

Of the Aire and into how many Regions it is deuided? Cap. 3.

NExt to the fire is the Aire which is an Element hotte and moyſt, and alſo moſt fluxible, pure and cleare, notwithſtanding it is far thicker & groſſer as ſome ſay, towards the Poles then elſwhere, by reaſon that thoſe parts are farthest from the ſun: And this Element is deuided of the naturall Philoſophers into thrée Regions, that is to ſay, the higheſt Region, the Middle Region, and the loweſt Region, which higheſt Region being turned about by the fire, is therby made the hotter, wherein all fierie impreſſions are bredde, as lightnings, fire drakes, blazing ſtarres and ſuch like.

The middle Region is extreame cold by contra oppoſition by reaſon that it is placed in the midſt betwixt two hotte Regions, & therefore in this Region are bred all cold watry impreſſions as froſt, ſnow, ice, haile, and ſuch like.

The loweſt Region is hotte by the reflexe of the Sunne, whoſe beames firſt ſtriking the earth, doe rebound backe againe to that Region, wherein are bred cloudes, dewes, raines, and ſuch like moderate watry impreſſions, which thrée Regions of the aire with the reſt of the Elements this figure doth plainely ſhew.



Of the Water, and whether it be round or not.

Cap. 4.

NExt to the Aire, is the Water, which is cold moyst, and fluxible, and being lighter then the Earth would of his owne nature surmount and couer the whole earth, had not God in the creation of the worlde deuided waters from waters (as the Booke of Genes. saith) and gathered together those waters that are vnder the firmament into certaine concauities of the earth, leauing other parts of the earth dry, and discouered, that man and beast might inhabite the same, and haue foode necessarie for their behoofe, so as now both water and earth doth make one entire and Spherical body, which is enuironed with the Aire.

Is not the Water a rounde bodye of it selfe without the earth?

Many late writers doe deny the whole body to bee round, affirming onely the Conuexe superficies or vpperface of the water to be round, for (say they) the earth being not altogether round the Concaue superficies of the water cannot be round, notwithstanding the most part of the auncient writers do affirme the whole body of the water to be round, saying that the water hath the like shape in his whole, that it hath in his parts: For the parts which are drops, are round, ergo the whole is round. Againe they proue the water of the sea to bee round by demonstration thus, suppose a ship to departe from the shore whereon some marke is set, which you may see with a right leauelled line standing at the sterne of the said shippe, but sayling further from the shore, you cannot see the marke any more standing vpon the sterne, but shall be faine to goe vp to the toppe of the mast to see it, by reason that the water being a round bodye riseth and swelleth in the midst, and so letteth your sight as this figure plainely sheweth.

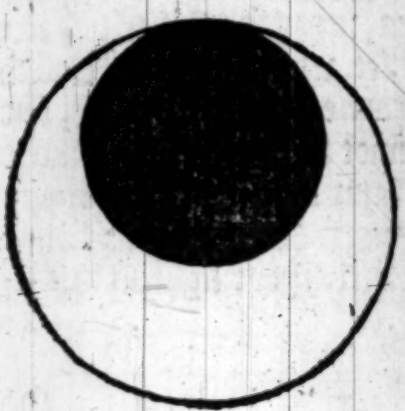
Of



Of the Earth and whether it be all round or not.

Cap. 5.

NExt to the Water is the Element of the Earth, which of his nature is thicke, heauy, cold, dry, and not flexible as is the water & aire, but is firme and apt to kæp his place, & though ſome deny the earth to be rounde becauſe of the high mountaines, and dæpe dales and vallies therin, which are nothing in compariſon of the whole earth to alter that roundnes which it hath by nature, yet Ariſtotle affirmeth in his ſecond Booke de cœlo & mundo, the fourtænth Chapter, that the earth of her owne nature is rounde, prouing ỹ ſame as well for that the Moone when ſhe is eclipſed in part, could not haue ſuch horned ſhape as this figure repreſenteth.



Unleſſe the earth were alſo round by the interpoſition whereof ſhee is Eclipſed, either totally or in part as hath bæne ſaid before, Againe he prooueth the roundnes of the earth by the altering of the Horizon, for in going from North to South, our Horizon altereth in ſuch ſorte as wee diſcouer thoſe ſtarres which wee coulde not ſée before but were cleane hidden from

our

our sight, some also deny that ỹ earth is in the middest of the world, and some affirme that it is moueable, as also Copernicus by way of supposition, & not for that he thought so in deede: who affirmeth that the earth turneth about, and that the sunne standeth still in the midst of the heauens, by helpe of which false supposition her hath made truer demonstrations of the motions & reuolutions of the celestiall Spheares, then euer were made before, as plainely appeareth by his booke de Reuolutionibus dedicated to Paulus Tertius the Pope, in the yeare of our Lord 1536. But Ptolomie, Aristotle, and all other old writers affirme the earth to be in the middest, and to remaine vnmoueable and to be in the very Center of the world, proouing the same with many most strong reasons not needful here to be rehearsed, because I think fewe or none do doubt therof; and specially the holy Scripture affirming the foundations of ỹ earth to be laid so sure, that it neuer should moue at any time: Again you shall find in the selfe same Psalme these words, He appointed the Moone for certaine seasons, and the Sun knoweth his going downe, whereby it appeareth that the Sun moueth and not the earth. But leauing this matter, we will now speake of the compasse of the earth, and of the Longitude and Latitude thereof.

Of the compasse of the earth, and of the diuersitie of measures according to diuers countries.

Chap. 6.

CAn the whole earth be measured?

Yea very well, for sith the earth and the water (as hath beene said before) doe make together, one whole Sphericall or round bodie, and that euery great Circle as well thereof as of the heauens, containeth 360. degrees, there is no more then to be done, but to allow for euery such degree 60. Italian miles, which differ not much from our English miles, so as in multiplying 360. degrees by 60 you shall finde the whole compasse of the earth to be 21600. miles. of which compasse if you would knowe the true Diameter, then hauing multiplied

the

the said compasse or circuit of 21600. miles by seuen, deuide the product thereof by 22. and the quotient together with the remainder, will shew the true Diameter which is 6872. miles, fiue furlongs, and $\frac{2}{11}$ of a furlong, and the halfe of that is the semi-Diameter of the earth which is 3436. miles, and $\frac{4}{11}$ of a mile: and as the Italians and we English men doe measure great distances on the earth by miles, so the French, the Spanish, and the high Almaines, doe measure such distances by leagues both by land and sea, and euery one differeth from other: for the French league containeth two of our miles, the Spanish league three, & the common league of Germanie foure, and the great league of Germanie containeth fiue of our miles, yea in some places of Germanie, as in Sueuia, the leagues are so long as a man shall skant ride three of them in a whole day. Againe the Grecians did measure the distances of the earth by furlongs, the Egyptians by signes, and the Persians by parasanges, all which measures doe greatly differ euen in the smallest parts, from whence all measures do take their first originall: for as well amongest the auncient men, as amongst them of latter dayes, foure barley kernels couched close together side by side, and not end long, are saide to make a finger breadth, and three finger breadthes an inch, and foure finger breadthes a palme or hand breadth, and three palmes or nine inches a span, and foure palmes or hand breadthes a foote, and two foote and a halfe to make a common pace, and fiue foote to make a Geometricall pace, of which kinde of paces, 125. doe make a furlong, and eight furlongs doe make an Italian mile, and foure such miles do make a common Germaine league, as hath beene saide before, but by reason that the barley kernels be not in all Countries of like bignesse, neither finger breadthes, inches, hand-breadthes, foote, nor any of the other measures are founde any where to bee equall: for the French foote of Paris is longer then ours by an inch, and the Italian foote is longer by two inches and more, and yet their miles are somewhat shorter then ours: and the Germaine foote (according to Stophlerus) is lesse then ours by two inches and a halfe. But to shew the diuersitie of measures would require a long discourse more intricable then profitable, and therefore I leaue to talke any further thereof, wishing you when we speake of miles, furlongs, paces, or foote, to consider the measure thereof

according

according to the inch or foote of our English standard.

Of the Longitude and Latitude of the earth.

Chap. 7.

WHat meane you by the Longitude and Latitude of the earth?

Longitude is as much to say as length, and Latitude signifieth breadth, for sith the earth is a bodye, it must néedes haue both length, breadth, and depth.

How define you such Longitude and Latitude, and how is it to be counted?

The Longitude of the earth in generall is that space or vpper face of the earth which extendeth from West to East, and againe from East to West: And the Laticude in generall is that space which extendeth North and South euen from the one pole to the other. Now to know how such Longitude & Latitude is to bee accounted, you must first vnderstande that the Equinoctiall Circle girding the earth in the very midst, is deuided into 360. degrées by reason of certaine Meridians which passing through the Poles of the world doe cut ech halfe of the equinoctiall in eight ene points, which being doubled doe make 36. spaces, euery space containing tenne degrées: and some do deuide the Equinoctiall with 36. Meridians, cutting ech halfe thereof into 36. pointes, which being doubled doe make 72. spaces, euery space containing 5. degrées, which commeth all to one reckoning, for fiue times 72. doe make 360. as well as tenne times 36. of which Meridians, be there neuer so fewe or many (for you may if you will make halfe as many Meridians as there be degrées in the Equinoctiall which amounteth to 180.) yet according to Ptolomie, that Meridian is said to be first and furthest Westwarde which passeth through the Ilands called Insulæ fortunatæ, for the West Indies were not knowne nor discouered in his dayes, nor yet long time after, since the discouerie whereof, the late Cosmographers of these dayes doe make the first Meridian to passe through the Ilandes called Azores, which Ilandes as appeareth by their

Cardes

Cardes are ſituated more Weſtwarde from the foreſaide Inſulæ fortunatæ, by fiue degrées, the reaſon that moueth them ſo to do, is becauſe the Mariners Compaſſe as they ſay will neuer encline to the true North Pole, but when they ſayle either by the Ile S. Marie or S. Michaell affirming that in euerie other place the Compaſſe doth varie from the true North, eyther by Northeaſting or Northweſting. And by thus altering the auncient placing of the firſt Meridian, they muſt likewiſe alter all the Longitudes ſet downe heretofore by Ptolomie or any other auncient writer, notwithſtanding the matter is eaſily holpen, for by adding to euerie Longitude Eaſtward fiue degrées, or by ſubtracting fiue degrées from euerie Longitude Weſtwarde, you ſhall not greatly varie from thoſe auncient Longitudes that bee truely ſet downe. But to returne againe to my firſt purpoſe, I ſay that wherſoeuer this firſt Meridian cutteth the Equinoctiall, there beginneth the firſt degrée of Longitude, which proceedeth Eaſtward vntill you come to 180. degrées, which being the one halfe of the earth, is as farre as you can goe Eaſtwarde, for then the earth being round, you muſt nedes turne againe Weſtwarde vntill you come to the 360. degrées, which is the laſt degrée of Longitude, and endeth where the firſt degrée beginneth: & therefore the Coſmographers meaſuring alwaies the Longitude by the degrées of the Equinoctiall, doe define Longitude to bee that portion of the Equinoctiall Circle, which is contained betwixt the firſt Meridian and the Meridian of any place ſuppoſed, but the diſtance betwixt any two ſuppoſed Meridians (neither of them being the firſt Meridian) is not called of them Longitude, but the difference of Longitude: For ſuppoſe the diſtance of the one Meridian, to be twentie degrées diſtant from the firſt Meridian, and the other but ten, theſe Longitudes you ſée are not like but doe differ, and therefore the diſtance betwixt any ſuch two places may be verie wel called the difference of Longitude, and not Longitude it ſelfe, which hath alwaies regard to the firſt Meridian and to none other.

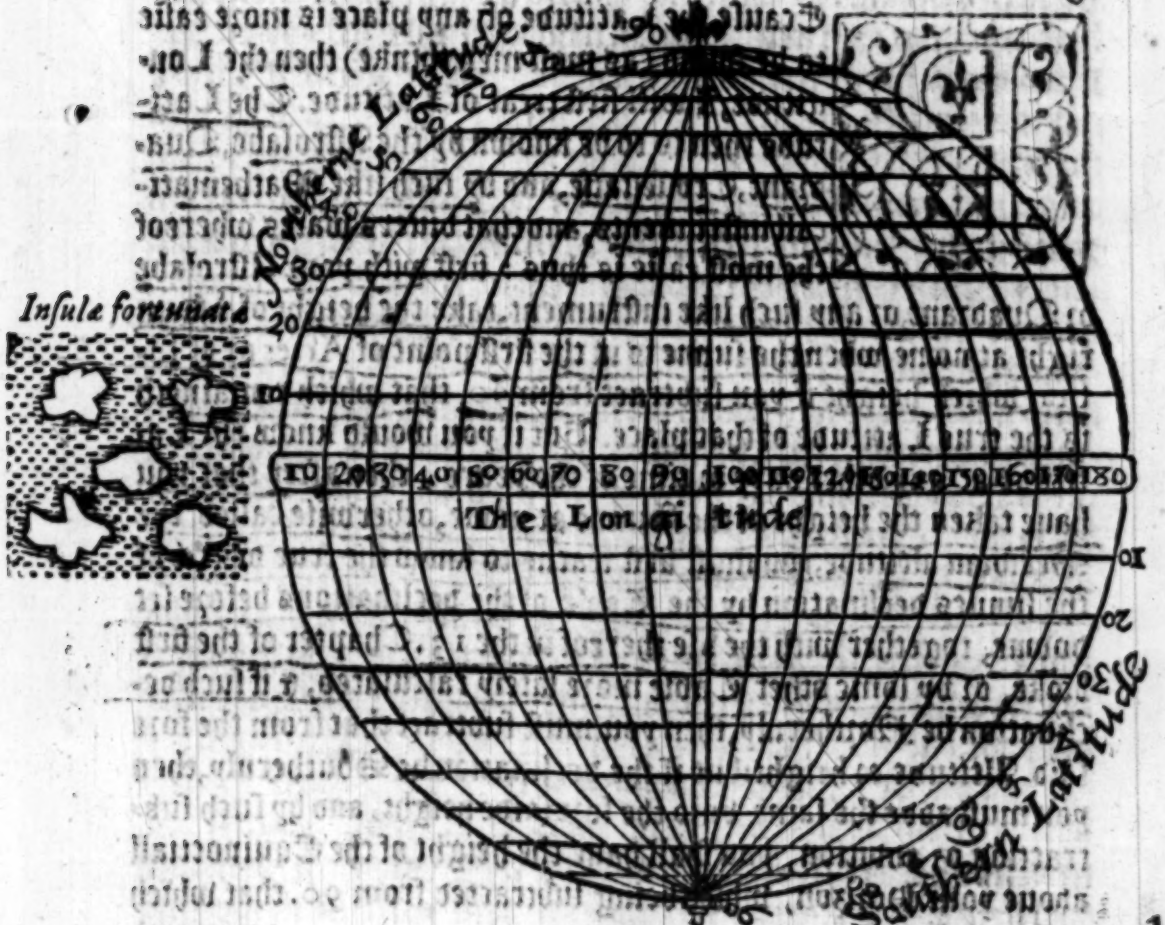
Define once againe what Latitude is?

Latitude is none other thing but the diſtance of any place from the Equinoctiall either towardes the North pole or towardes the South pole, ſo as there be two kinds of Latitudes, the one Northerne

therne, and the other Southerne. And such Latitude is measured vpon the Meridian which passeth through many places supposed. For euery Meridian is also deuided into 360. degrees, and by reason that the Equinoctiall girdeth all such Meridians in the verie midst, it deuideth them all into foure equall quarters euery quarter containing 90. degrees, which is the greatest Latitude that any place can haue, as you may see in this figure following, whereof the first Meridian on the left hand is put to signifie according to Ptolomie, that which passeth through the Fortunate Ilands, or by the Azores according to the modern Cosmographers (if you will haue it so) containing the degrees of the Latitude both Northward and Southward, and through the midst of all the Meridians passeth the Equinoctiall containing the degrees of the Longitude.

The Azores doo meane here and the degrees of Latitude

The figure of the Longitude and Latitude of the world.



180
180
360

What be the other manifold Circles in this figure deuiding the Meridians on each side of the Equinoctiall, as well towards the North pole, as towards the South pole.

They are called Parallels, whereof we shall speake in the 17. Chapter, in the meane time marke well this figure that therby you may the better conceiue what is ꝓ longitude & latitude of the earth.

Vnderstanding now the Longitude and Latitude of the whole earth, I am desirous to know how the Longitude and latitude of euery seuerall place of the earth or sea is to be found out, and how farre any place is distant one from another.

How to know the Latitude of any place, as well in the day as in the night.

Chap. 8.

BEcause the Latitude of any place is more easie to be found (as most men thinke) then the Longitude, I will first treat of Latitude. The Latitude then is to be known by the Astrolabe, Quadrant, Crossestaffe, and by such like Mathematicall instruments, and that diuers waies whereof the most easie is thus: first with your Astrolabe or Quadrant, or any such like instrument, take the height of ꝑ Sun right at noone, when the sunne is in the first point of Aries or of Libra, which height if you subtract from 90. that which remaineth is the true Latitude of that place. But if you would know the Latitude at any other daye or time of the yeare, then after that you haue taken the height of the Sunne at noone, otherwise called the Meridian altitude, you must first learne to know the true degree of the sunnes declination by the Table of the declinations before set downe, together with the vse thereof in the 13. Chapter of the first booke, or by some other Table more lately calculated, & if such declination be Northernly, then you must subtract that from the fore said Altitude or height: but if the declination be Southernly, then you must adde the same vnto the foresaide height, and by such subtraction or addition, you shall haue the height of the Equinoctiall aboue your Horizon, which being subtracted from 90. that which

remaineth

remaineth is the true Latitude of that place: and to be sure in taking the Meridian altitude, it shall bee needefull to take it diuerse times one after another, with some little pawse betwixt, to see whether it increaseth or decreaseth, for if it doth increase, then it is not yet full noone, but if it decreaseth then it is past noone. This last way of finding out the latitude, is, & hath bene most commonly taught, as well by the auncient, as moderne writers, as a most sure and ready way of finding the Latitude of any place.

What if the Sunne doe not shine at noone, nor perhaps all that day?

Then you must carrie vntill night that some starre appeare, which you perfectly knowe, and such a one as doth riseth and setteth. And hauing taken the Meridian altitude of that Starre, with your Astrolabe or Quadrant, you must learne what declination hee hath, and whether it bee Northerne or Southerne. For if the Starre hath North declination, then you must subtract his declination from his Meridian altitude, and the remainder shall bee the Altitude of the Equinoctiall, which being taken out of nintie, shall bee the Latitude of the place, or eleuation of the pole: but if the declination of the starre bee Southernly, then you must adde his declination to his Meridian Altitude, and that Summe shall bee the Altitude of the Equinoctiall, which being taken out of 90. the remainder shall bee the eleuation of the Pole. As for example, supposing that you knowe the Starre called Arcturus or Bubulcus, and that you finde his Meridian altitude by your Astrolabe or Quadrant to bee 59. degrees 30. minutes and also that you haue learned by some Table, that his declination to the Northwarde is 21. degrees 30. minutes: heere by taking his saide declination because it is Northernly, out of his Meridian altitude, you finde the remainder to bee 38. degrees which is the Altitude of the Equinoctiall, which being taken from 90. the remainder will bee 52. degrees, which is the Latitude of the place whereas you made your obseruation, and this is a farre more readie waye, then to waite all night to take the Meridian altitude, and also the depression of such a Starre as neuer setteth, which is seldome done in one selfe night. And therefore I woulde wishe all Mariners to acquaint themselues with manie Starres that doe both ryse and set, and so shall they

be sure to finde one such starre or other, to bee at his Meridian altitude at nine houre of the night that they desire, if the starres doe shew.

How to know the Longitude of any place.

Cap. 9.

THough the Longitude may bee found out by diuers waies not easie for euerie mans capacitie, yet because Gemma Frisius thinketh none so sure as to know the same by the Eclipse of the Moone, (which also as hee sayth) may sometime faile by reason of the diuersitie of aspects and Latitude of the Moone, and for that cause hath inuented a more ready way to finde out at all times the Longitude of any place, I minde here therefore briefly to shewe you first the order of finding out the Longitude by the Eclipse of the Moone, and then how to find out the same by that readie way which hee hath inuented: the order then to knowe it by the Eclipse of the Moone is thus: First you must learne by some Ephemerides at what houre the Eclipse shall bee in some place, where you knowe alreadie by some Table the Longitude, that done, you your selfe or some other for you, must the same day of the Eclipse obserue by the Astrolabe at what houre the eclipse beginneth in that place, wherof you know not the Longitude: For if the Eclipse doe beginne in both places at one selfe houre, then assure your selfe that both places haue one selfe Longitude, but if it beginne sooner or later, then there is difference betwixt them, according to the varietie of the time, which difference is thus to bee knowne: take the lesser summe of houres out of the greater, and there shall remaine either houres, or minutes, or both, if houres, then multiply the same by fifténe, if minutes, deuide the same by foure, (for in this account fifténe degrées doe make one houre, and foure minutes doe make one degrée) and adde the difference so found to the Longitude, if the Eclipse doe appeare there sooner: if later then subtract the said difference from the knowne Longitude, and that which remaineth will shew the vnknowne longitude. But note by the way, that if there remaine a-

ny

ny minutes after the diuision, you must multiply those minutes by 15. and so shall you haue the minutes of degrées.

Shew the vse of this rule by some example.

For example I finde by the Tables of Ptolomey that the longitude of Paris in Fraunce is 23. degrées, and by some Almanacke or Ephemerides I find that the Eclipse doth begin there at three houres after midnight, now by this I woulde know the longitude of Tubing a famous Cittie in Sueuia, which is a region of Germany, at which towne in the verie daye of the Eclipse I cause to bee obserued by Astrolabe at what houre the Eclipse beginneth there, and I finde that it beginneth at 3. of the clocke and 24′. after midnight, then by subtracting the lesser number of time out of the greater, I finde the remainder to bée 24′. which béeing deuided by 4′. which doe make one degrée, the quotient shall bee 6. degrées, and that is the difference, which being added to the knowne longitude of Paris (because the Eclipse is sooner there than at Tubing) it maketh in all 9. degrées, whereby I gather that the longitude of Tubing is 29. degrées, by this meanes all the Tables of Cosmographers are most commonly made, and yet manie times they greatly differ in their longitudes for lacke perhaps of vsing diligence in taking the right houre and moment of the Eclipse, and for not duely considering the diuers aspects, and what latitude the Moone hath at that instance which may cause great error.

A readie way to finde out the longitude of anie place, inuented by Gemma Frisius.

Cap. 10.

THat way is done by the helpe of some true Horologie or watch apt to bee carried in iournying, which by an Astrolabe is to bée rectified and set iust at such houre as you depart from the place where you are, to goe to anye other place whereof you are desirous to know the Longitude, in which your going you must be diligent to sée that

your watch neuer ceaſe going, and being arriued at that place whereof you ſæke to know the longitude, you muſt tary vntill the Inder do iuſtly touch the pricke of ſome perfect houre, and alſo at that inſtant, to ſée what houre it is by your Aſtrolabe, for if your Aſtrolabe and watch doe both agrée in one, then aſſure your ſelfe that there is no difference of longitude, but that you haue trauelled ſtil vnder one ſelfe Meridian either towards the North or South. But if they differ one houre or certaine minutes, then reduce them to degrées, or to the minutes of degrées in ſuch order as is before taught, and thereby you ſhal find the longitude which you deſire to know. But to take the longitude of any place vppon the ſea by this manner of way, moſt men thinke it were a great deale better to do it by the helpe of a great houre glaſſe, made to run 24. houres which muſt be watched when it is ready to run out, that it may be immediately turned: for watches made of Iron or Steele will ſoone ruſt vpon the ſea. This way of taking the longitude and many others I doubt not but that M. Borrough hath tryed, and thereby is able to iudge which is beſt, wherefore in mine opinion hee may doe his countrie great good by ſetting downe in writing that way which hee by experience knoweth to bee beſt and readieſt, for want whereof the Mariners cardes doe make the ſea men oft to erre in their voiages.

Another way taught by Appian to find out the longitude of any place with the croſſe ſtaffe by knowing the diſtance betwixt the Moone and ſome knowne ſtarre that is ſituated nigh vnto the Ecliptique line.

Chap. 11.

FIrſt ſæke to know by the Aſtronomical Tables the true mouing of the Moone according to the longitude at the time of your obſeruation at ſome certaine place, for whoſe Meridian the Rootes of thoſe Tables are calculated & verefied. Alſo you muſt knowe the degrée of longitude of ſome fixed ſtarre nigh vnto the Ecliptique going either next before

before or else next after the mouing of the Moone, then you must seeke out the distance of the mouing of the Moone and of the sayde starre, which distance once had, apply the crosse staffe to your eye, and moue the crosse vp and downe vntill you may see the center of the body of the Moone with the one ende of the crosse and the foresaid fixed starre with the other end of the crosse, so shall the crosse shew you by the degrees and minutes marked vpon the staffe, the distance of the Moone and of the foresaide starre answerable to the place of your obseruation, which being set downe, set downe also the distance betwixt the Moone and the foresaid starre that was first calculated, & then take the lesser out of the greater, so shall remaine the last difference, which may bee rightly called the diuersitie of aspectes, which difference if you deuide by the mouing which the Moone maketh in one houre, you shall knowe thereby the time in which the Moone is or was ioyned with the first distance of the foresaid starre, then hauing conuerted that time into degrees and minutes, adde or subtract the product thereof to or from that Meridian, vnto which the Tables (whereby you first calculated the mouing of the Moone) were verified, that is to say, if the distance betwixt the Moone and ỹ fixed starre of your obseruation be lesser, then adde the degrees and minutes to the knowne Longitude, so shall you find the place of your obseruation to be more Eastward, but if it be greater, then subtract the degrees and minutes from the knowne Longitude, and the place of your obseruation shall bee more Westward. All which rules Gemma Frisius affirmeth to be true, so as the Moone be more Westward than the fixed starre: for if at the time of your obseruation the Moone bee more Eastward, then you must worke cleane contrarie, that is to saye, if the distance betwixt the Moone and the fixed starre be lesser, you must subtract the degrees and minutes from the knowne Longitude, so shall the place of your obseruation be more Westward: but if it be greater, then you must adde the degrees and minutes vnto the knowne Longitude, and you shall finde the place of your obseruation to be more Eastward.

How to know the distance of places, that is to say, how many miles one place is distant from another, and howe manye waies places are said to differ in distance one from another.

Cap. 12.

THe distance may bee knowne diuers wayes, that is either Arithmetically, Geometricallye, or by the Tables of *Sinus*. But before I shew you the order of any of these wayes, you haue to vnderstand that any two places doe differ in distance one from another one of these 3. maner of waies, that is, either in latitude only, or in longitude only, or els in both: if two places hauing one selfe longitude do differ onely in latitude, then according to the Arithmetical way you must subtract the lesser latitude out of the greater, & the remainder shall be the difference, which being multiplied by 60. will shew ỳ number of miles: as for example, London and Roan, hauing in a manner one selfe longitude, doe differ onely in latitude, for the latitude of London is 51. degrées 32′. and the latitude of Roan is 49. degrées and 10′ which being the lesser latitude and therefore to be taken out of 51. degrées 32′. there remaineth 2. degrées 22′. which 2. degrées being multiplied by 60. maketh 120. whereunto if for the 22′. annexed to the degrées you adde 22. miles (for euery minute is a mile) it shall make in all 142. miles, which by a right line is the true distance betwixt London and Roan. But you haue to note that the difference of 2. sundrie latitudes is not to bee knowne by subtracting the lesser out of the greater, vnlesse both the places be so situated, as both may haue either North latitude or South latitude, for if the one place haue North latitude and the other South latitude, the difference is to bee knowne by addition, and not by subtraction: as for example, Naples in Italy hath 41. degrées of North latitude, and la Madalena in Aphricke not far from Mamcongo, hath 8. degrées of South latitude, both places hauing one selfe Meridian, here the difference of these two latitudes is to be knowne by addition, and not by subtracting the lesser out of the greater, for 8. and 41. being added together do make 49. and that is ỳ true difference, which being multiplied by 60. maketh 2940 miles

miles. So likewise the difference of the two longitudes is not alwaies knowne by subtracting the lesser out of the greater, vnlesse the two places haue both East longitude, or els both West longitude: As for example Lisbona in Spaine hath in East longitude 13 degrées and Cap de los slauos in the West Indies hath in West longitude 334. degrées: here the difference of these two longitudes is not to be knowne by taking the lesser out of the greater, but thus, first take 334. out of 360. & there will remaine 26. degrées, whereunto if you ad the East longitude for Lisbona, which is 13. degrées it will make in all 39. degrées, which is the true difference of the 2. longitudes, for if you shoulde take 13. degrées out of 334. there woulde remaine 321. which is not the true difference. But to know the distance of two places differing in longitude, this Table here following is nedfull.

The Table of miles aunswerable to one degree of euerie seuerall latitude.

1			2			3			4			5			6		
D	M	S	D	M	S	D	M	S	D	M	S	D	M	S	D	M	S
1	59	59	16	57	41	31	51	26	46	41	41	61	29	5	76	14	31
2	59	58	17	57	23	32	50	53	47	40	55	62	28	10	77	13	30
3	59	53	18	57	4	33	50	19	48	40	9	63	27	14	78	12	28
4	59	51	19	56	44	34	49	45	49	39	22	64	26	18	79	11	27
5	59	46	20	56	23	35	49	9	50	38	34	65	25	21	80	10	25
6	59	40	21	56	1	36	48	32	51	37	46	66	24	24	81	9	23
7	59	33	22	55	38	37	47	55	52	36	56	67	23	27	82	8	21
8	59	25	23	55	14	38	47	17	53	36	7	68	22	29	83	7	19
9	59	16	24	54	49	39	46	38	54	35	16	69	21	30	84	6	16
10	59	5	25	54	23	40	45	58	55	54	25	70	20	31	85	5	14
11	58	54	26	53	56	41	45	17	56	33	33	71	19	32	86	4	11
12	58	41	27	53	28	42	44	35	57	32	41	72	18	32	87	3	8
13	58	28	28	52	59	43	43	53	58	31	48	73	17	33	88	2	5
14	58	13	29	52	29	44	43	10	59	30	54	74	16	32	89	1	3
15	57	57	30	51	58	45	42	26	60	30	0	75	15	32	90	0	0

De

Describe this Table.

This Table is deuided into 6. collums, euerie collum containing, first the degrees of latitude, and then the miles and seconds of miles answerable to euery degree, for euery degree of the verie Equinoctiall it selfe is in value 60. miles, but the further you goe from the Equinoctiall either Northward or Southward, euerie degree of latitude is lesser in value than other, and containeth fewer miles, as you may easily see by the said Table, proceeding from one degree to 90. which is the greatest latitude that any place can haue.

How to knowe by the helpe of the foresaide Table the distance of two places differing onely in longitude.

Chap. 13.

YOu must multiplye the difference of the longitudes by the number of miles answerable to the latitudes of the said places, omitting alwaies the seconds of miles set downe in the saide Table, because in this account they are of smal importance: as for example, London and Antwerpe, hauing both in a manner one selfe latitude, doe differ onely in Longitude 6. degrees 42′. which difference being multiplyed by 37. miles answerable to 51 degrees of latitude, as you see in the Table, doe make in all 247. miles and 54″. of a mile. But in making this multiplication, you must first multiply the 6. whole degrees by 37. and the product thereof will amount to 222. then by the rule of proportion you may finde out the value of the minutes annexed to the degrees of the difference of Longitude in saying thus, if 60′. which is one degree, doe require 37. miles, what shall 42′. require. And by working according to the rule of proportion, you shall finde the fourth number which you seeke to bee 25. miles and 54″. which being added to the first product 222. maketh in all 247. miles and 54″. of a mile, which wanteth but 6″. to make vp another mile.

How

How to finde out the true distance of two places differing both in longitude and latitude by the Arithmeticall way.

Chap. 14.

HOw is that done?

First, take the difference of the Longitudes and Latitudes of both places by subtracting the lesser out of the greater, then conuert the same into miles by multiplying the difference of the two Longitudes into the miles that bee answerable to the Latitude of each place, which miles you shall finde in the Table aforesaide, and if there bee any minutes annexed to the degrées of the difference of Longitude, then reduce the same also to miles by the rule of proportion, as before is taught, and hauing added the two products together, halfe the summe, and set it by it selfe. Then multiplie the difference of the Latitudes into 60. miles, and adde thereunto the fraction of minutes annexed to the said difference if it hath anie fraction, following for euerie minute one mile, and set that number also by it selfe: that done, square the summes reserued, that is to say, multiplie ech one part by it selfe into it selfe, and hauing added the two products together into one Summe, séeke out the square roote thereof, and that shall bee the true distance of the two places. As for example, if you would knowe the true distance betwixt London and Venice, first you must know by some Table the Longitude and latitude of both townes, wherefore finding the Longitude of London to be 19. degrées, 54′. and the latitude thereof to be 51. degrées, 32′. And the longitude of Venice to be 35. degrées, 30′. and the latitude thereof to bee 44. degrées, 45′. Now by subtracting the lesser Longitude out of the greater, I finde the difference of Longitude to be 15. degrées, 36′. and by subtracting the lesser latitude out of the greater, I finde the difference of latitude to be 6. degrées, 47′. Then knowing the latitude of London to bee 51. degrees, I resort to the Table of miles appointed for euerie degree of latitude before set downe, and there I find that to 51. degrees of latitude do answere 37. miles and certaine

taine seconds, which being of small moment are not woont to bee reckoned. Then in multiplying the difference of the Longitudes which is 15. degrées 36′. by 37. miles I finde the product of the 15. degrées so multiplyed to be 555. and because there be 36′. annexed to the foresaid 15. degrées, I séeke by the rule of proportion to know how many miles that fraction containeth, in saying thus, if 60. require 37. what shal 36. require: and I find 22. miles, which being added to 555. maketh 577. then by séeking in the foresaide table how many miles bee answerable to the latitude of Venice, which is 44. degrées, I finde the number of miles to bee 43. by which number I multiply once againe the difference of longitude, which is 15. degrées, 36′. the product whereof, together with the fraction annexed thereunto being conuerted into miles by the rule of proportion, as before, doth amount to 670. which summe being added to the former conuerted longitude, which is 577. maketh in all 1247. the halfe whereof is 623. which halfe number I reserue by it selfe, that done I multiply the difference of the latitude, which is 6 degrées 47′. by 60. miles, in saying 6. times 60. maketh 360. whereunto I adde for the 47′. annexed 47. miles, and it maketh in all 407. which summe I reserue also by it selfe. Then I multiplie the first reserued number into it selfe, the product whereof is 388129. That done, I multiplie the second reserued number also into it selfe, the product whereof is 165649. which two last productes being added together, do make in all 553778. whereof the square rote being taken, is 744. miles, which is the true distance of Venice by a right line from London. And to the intent that the order and working herein may more plainely appeare vnto you, I haue set down all the particular numbers of the same here by themselues, as it were in a Table

	Longitude.	Latitude
London.	19. degr. 54′.	51. degr. 32′.
Venice.	35. degr. 30′.	44. degr. 45′.
The difference of their longitudes and Latitudes.	15. degr. 36′.	6. degr. 47′.

The

The difference of the longitudes conuerted into miles: for London is	577
For Venice,	670
The summe of the two conuerted longitudes added together, is	1247
The halfe whereof, which is the first reserued number, is	623
The second reserued number, which is the difference of the latitudes, conuerted into miles, is	407
The summe of the first reserued number multiplyed into it selfe, is	388129
The summe of the second reserued number multiplied into it selfe, is	165649
The summe of both added together, is	553778
The square roote whereof, which is the summe of the miles, is	744

How to finde out the distance betwixt two places, differing both in longitude and latitude by helpe onely of a demicircle deuided into 180. degrees without any Arithmeticke.

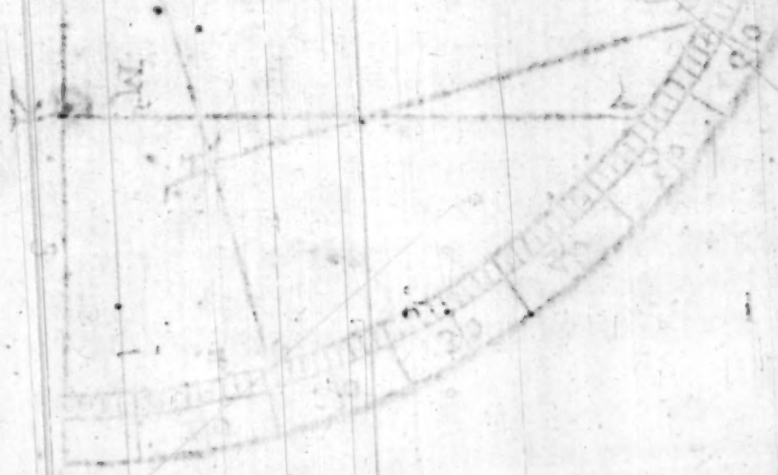
Cap. 14.

BVt now because the way before taught to find out such distance by the Arithmeticall way may séeme perhaps to some folkes verie busie and tedious, I haue thought good therfore to set downe this other way which was sent me not long since from my louing friend Master Wright of Caius Colledge in Cambridge who is well learned in the Mathematicals, and is so apt thereunto by nature, as hee is like inough to attaine to such perfit knowledge therein

knowledge therein as he may be able thereby hereafter greatly to profect his country, if for want of sufficient exhibition he be not forced to leaue so noble a studie, wherefore I wish with all my heart that all Gentlemen of abilitie were minded to shew their liberalitie towards him in that behalfe. But to returne to my matter, I say that the way to find out the foresaid distance is this here following: first hauing drawne a demi-circle vpon a right Diameter (the larger that the demi-circle is, the better) and diuide the same into 180. degrées, like vnto this hereafter described, and marked with the letters a b c d. wherof d. is the center and a. c. the Diameter. Then learne first by some Table to know the longitude and latitude of both places, and the difference of their longitudes, as you did before in séeking to know by the Arithmeticall way the distance betwixt London and Venice, the difference of whose two longitudes is 15. degrées, and 36'. as you may sée in the former Table: for in working by this way, you haue chiefly to séeke out in the circumference of ỹ demicircle but three things, that is, 1. first, the difference of the two longitudes, 2. secondly, the lesser latitude, and 3. last of all the greatest latitude. Knowing therefore the difference of the said two places in longitude to be 15. degrées, 36'. séeke out the same in the demicircle, beginning to count at A. & so procéede towards B. And at the end of those degrées and minutes set downe a pricke marked with the letter e. vnto which pricke drawe a right line by your ruler from D. the center of the demicircle. That done, séeke out the lesser latitude, which is 44. degrées, and 45'. in the foresaid demicircle, beginning to account the same from the pricke e. and so procéede towards the letter B. and at the end of the said lesser latitude, set downe another pricke marked with the letter g. from which pricke or point draw a perpendicular line which by helpe of your squire or compasses may fall with right angles vpon the former right line drawne from D. to e. and where it falleth, there set downe a pricke marked with the letter h. That done séeke out the greater latitude, which is 51. degrées, and 32'. in the foresaid demicircle, beginning to account the same from A. towardes B. and at the end of that latitude set downe another pricke marked with the letter I. from whence draw another perpendicular line that maye fall by helpe of your squire or compasse with right angles vpon the Diameter A. C. and there make a pricke marked with the letter K

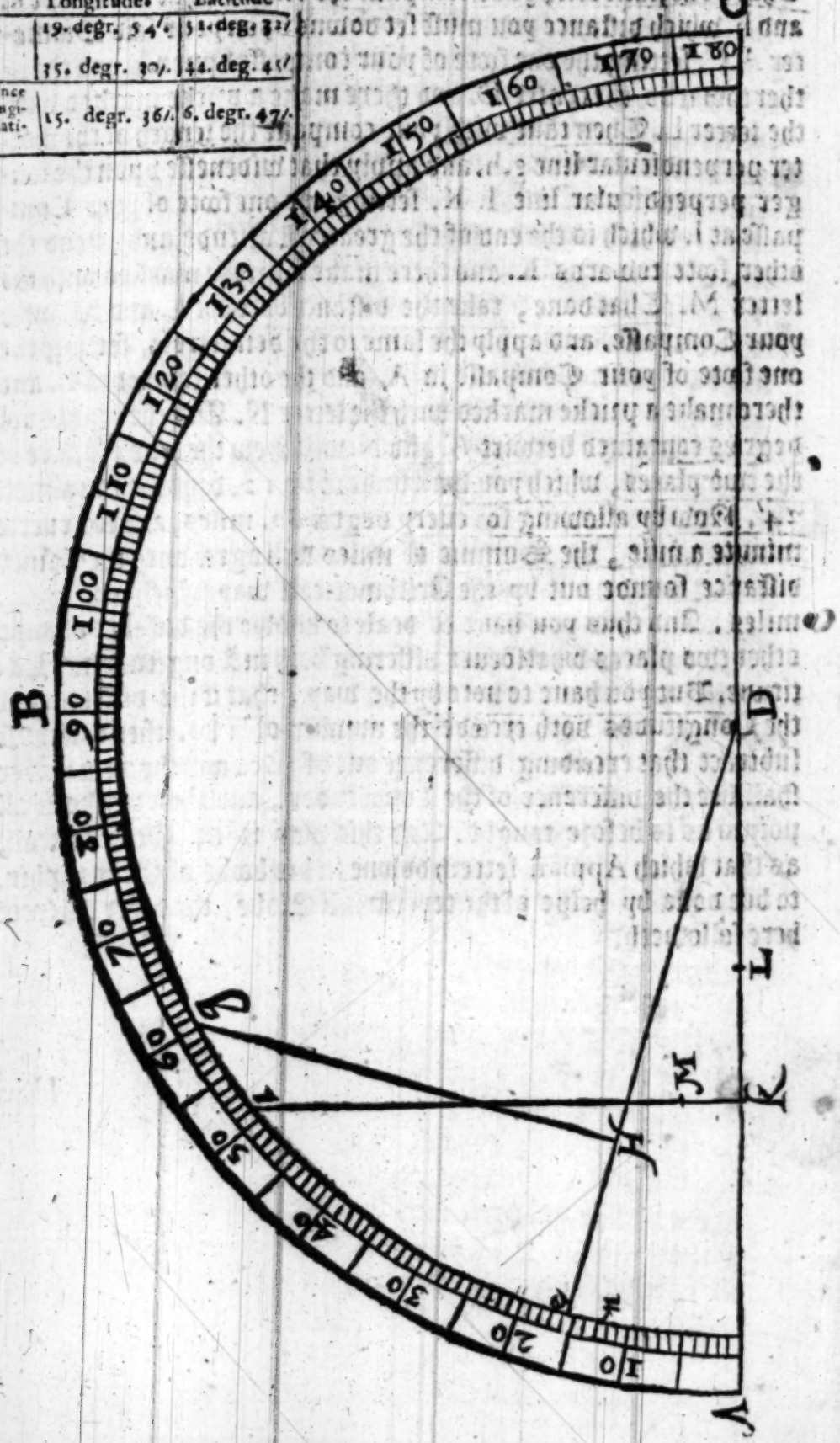
That

That done, take with your compasse the distance that is betwixt k. and h. which distance you must set downe vpon your said Diameter A.C. setting the one foote of your compasse vppon k. and the other towards the center D. and there make a pricke marked with the letter L. Then take with your compasse the length of the shorter perpendicular line g.h. and apply that wideneſſe vpon the longer perpendicular line I. K. setting the one foote of your Compasse at I. which is the end of the greater Latitude, and extend the other foote towards K. and there make a pricke marked with the letter M. That done, take the distance betwixt L. and M. with your Compasse, and apply the same to the demicircle, setting the one foote of your Compasse in A. and the other towardes B. and there make a pricke marked with the letter N. And the number of degrées contained betwixt A. and N. will shew the true distance of the two places, which you shall finde to be 12. degrées and almost 24'. Now by allowing for euery degrée 60. miles, and for euerie minute a mile, the Summe of miles will agrée with the former distance founde out by the Arithmeticall way which was 744. miles. And thus you haue to deale to knowe the distance of anye other two places whatsoeuer, differing both in Longitude and Latitude. But you haue to note by the way, that if the difference of the Longitudes both exceede the number of 180. then you must subtract that exceeding difference out of 360. and the remainder shall bee the difference of the Longitudes, and then worke in all points as is before taught. And this way is as Geometricall, as that which Appian setteth downe in his booke of Geographie, to bee done by helpe of the terrestriall Globe, the order whereof here followeth.



How

	Longitude.	Latitude.
London.	19. degr. 54′.	51. deg. 32′
Venice.	35. degr. 30′.	44. deg. 45′
The difference of their longitudes and latitudes is	15. degr. 36′.	6. degr. 47′.



How to find out the distance of the places by the Geometricall way.

Chap. 15.

HOw is that done?

Most readily and easilye by helpe of a terrestriall globe in this maner following. First take the distance of the two places by extending your compasse vpon the Globe, from the one place to the other, which if you would know how many miles it comprehendeth, apply the same distance so taken vnto the Equinoctiall line, setting the first foote of your Compasse vpon the first Meridian in that point, whereas it cutteth the Equinoctiall, then se how many degrees of the Equinoctiall are comprehended betwixt the two feete of your Compasse, and multiply those degrees by 60. and the product thereof shall shew you how many Italian miles such distance is in length. But if either of the places or both, be wanting and not expressed in the Globe, then you must learne by the Tables of Ptolomey or of some others, as of Appian, Gemma Frisius, Orontius or such like, the longitude and latitude of the said places, that done, hauing sought out the longitude of the first place in the Equinoctiall, turne the globe about with your hand vntill you haue brought the longitude right vnder the brazen Meridian, which being stayed there, seeke out in the saide Meridian the latitude of the said place, and there set a marke vpon the globe, for there the place should stand, and doe in like manner to finde out the seconde place: Then by extending your Compasse from the one marke to the other, you shall haue the true distance, which distance if you apply to the Equinoctiall like as before is taught, the degrees thereof being multiplyed by 60. will shewe you how many myles those two places are distant one from another.

May not the distance of places bee found out as well by an vniuersall Map as by the globe terrestriall.

Yes indeede and more readily by reason that for the most parte euery Map hath his proper scale, so as you need to do no more but to take the distance of the 2. places with your Compasse, and to

apply the same to the skale shewing the miles or leagues.

What if the Map haue no skale?

Then you must seeke out the distance by such meanes as I doe shew in my Treatise of the vse of vniuersall Mappes, and also in my description of Plancius his Map.

I pray you in the meane time proceede in shewing me the third way of finding out of the distance of places which you said was *per tabulas Sinuum*.

The order of finding out the distance of 2. places differing both in longitude and latitude per tabulas Sinuum, is plainly set down before in the end of my Arithmeticke, whereas I do make a plaine description of the said Tables, and do shew the vse thereof as well by this as by diuers other examples, wherfore I wish you to resort to that treatise and you shall haue your desire. For hauing for this time sufficiently spoken of the Longitude, Latitude and distance of places, and how the same is to bee found out, I thinke it meete to treate of the 5. Zones, of Climes and Parallels, whereunto the ancient Cosmographers thought good to deuide the earth, to the intent that euery part thereof might bee the better knowne how it is situated either Northward or Southward, whether it bee hot or cold, or betwixt both, and of what length the day and night is in euery place, and what manner of shaddow the Sunne yeeldeth euery where, and such like accidents, and first of the 5. Zones.

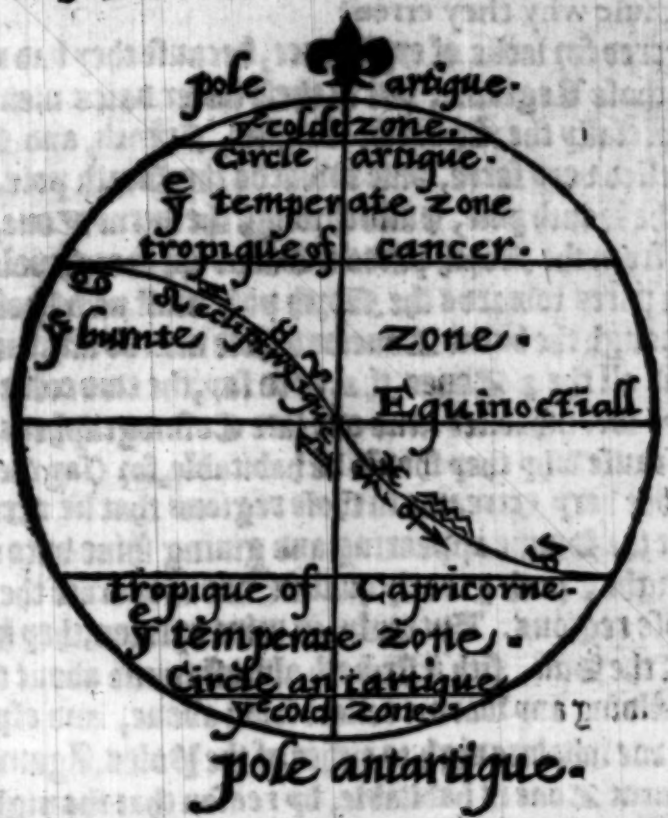
Of the 5. Zones.

Cap. 16.

THe most ancient Cosmographers considering how the Sun by his oblique, and variable course did warme with his beames one parte of the earth more than another, gathered thereby that the earth had three temperatures that is to say, extreame hot, extreame cold, and a meane temperature, that is, neither too hotte, nor too colde: And therefore to shew vs vnto which of these temperatures, any part of the earth was subiect, they deuided the earth into 5. Zones,

answer-

answerable to the 5. Zones of the firmament, by helpe of the Equinoctiall and the 4. lesser Circles before described in the first part of this treatise, the 20. Chapter, and are there set forth in figure, which figure I thought good to set downe againe in this place to the intent you might the better remember what was saide there touching the Zones.



But other Cosmographers comming afterward, not satisfied with the 5. Zones, because they shewe nothing but the situation and the three temperatures of the earth, did deuide the earth into certaine Climes and Parallels, to finde out thereby the length of the day and night in euerie place, and the true latitude thereof as Ptolomey and many others after him haue done, making such diuisions as we shall speake of hereafter. But truly I thinke with Mercator, that the best and most exact way of deuiding the earth to serue all purposes is to be made by degrees and minutes, wherin is lesse error than in Climes & Parallels, neither can Climes or Parallels be so well described when you draw nigh to any of the Poles, for that the spaces as wel betwixt the Parallels as betwixt

the Meridians do grow continually straighter and straighter, as you may see in the figure of Parallels hereafter following.

I remember that in the 20. Chapter whereas you described the 5. Zones, you said that the ancient men did greatly erre in affirming 3. of the Zones to be vnhabitable, that is, the two colde Zones and the hot Zone, I pray you therefore shew me here the cause why they erred?

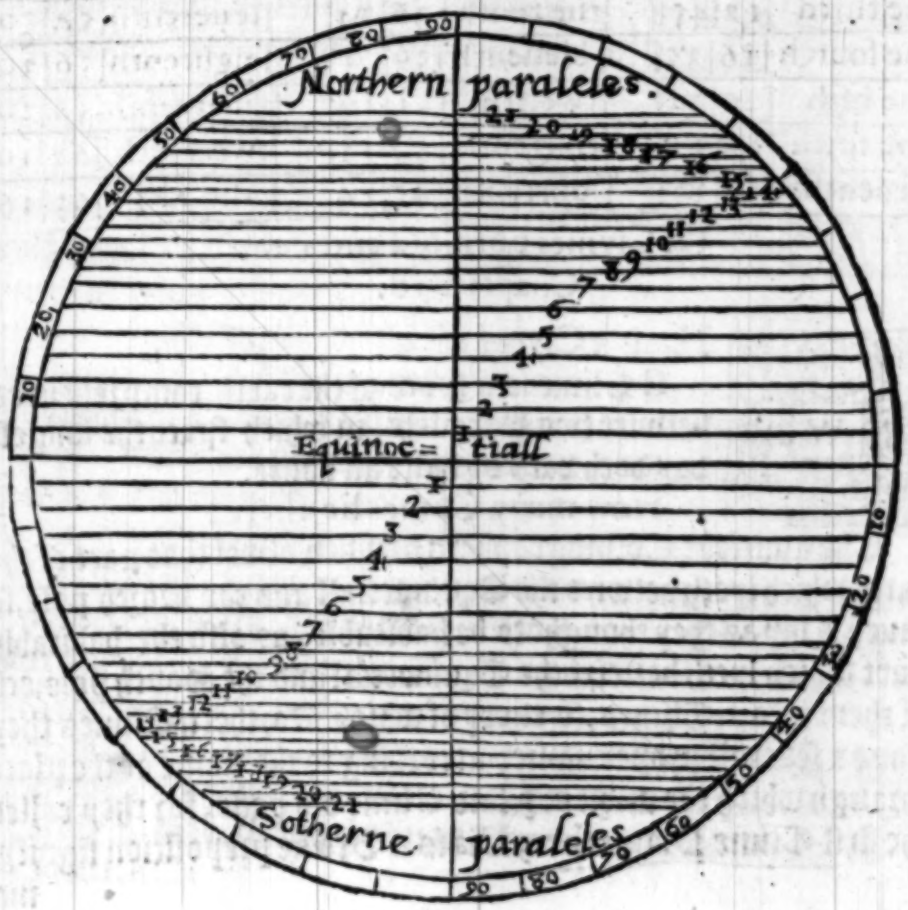
They erred for lacke of experience, because they had neuer traueled into those Regions, but in these latter daies men of diuers nations, specially the Spanish, English, French, and Flemmish haue trauelled very farre, some towards the North pole, and some towards the South pole, & also through the burnt Zone, for those that sayle from the North parts towards the South pole, or from the South parts towards the North pole, must néds passe in their voiage through the burnt Zone: and these men do affirme that they haue found all the 3 Zones, that is to say, the two colde and hotte zones to be wel inhabited. And our late Cosmographers do not let to render cause why they should be habitable, for (say they) though the colde bee very extreame in those regions that lie next vnto the Poles, yet the Sunne appearing and giuing shine vnto them both day and night, doth greatly qualifie and moderate the extreame cold of those regions. But truly, in mine opinion, they haue small comfort of the Sun, sith it striketh almost round about their féete, without yéelding any warme reflexe from aboue, and especially to those that doe inhabite nigh to either of the Poles. Againe, they say that the burnt Zone is habitable, by reason that the night to them is cõtinually as long as the day, the coleneſſe whereof doth greatly refresh the extreame heat of the day, But now let vs returne to our purpose, and speake somewhat of the Climes and Parallels, and because euery Clime consisteth of two Parallels, I thinke it best to speake first of Parallels.

Of Parallels.
Cap. 17.

WHat be Parallels.

Parallels bee lines either right or circular alwayes equally distant one from another so as they can neuer méete. And of Parallels that are to be considered in the Spheare,

Spheare, some make 3. kinds, according to their threefold signification, for some are called the Parallels of the sunne, who in departing from the Equinoctial towards any of the Poles, maketh euery day throughout the yeare one Parallel, so as in going from the Equinoctiall to the Tropique of Cancer, hee maketh 182. Parallels. And as many againe in going from the Equinoctiall to the Tropique of Capricorne. The second kinde of Parallels are called the Parallels of Latitude, And the third the Parallels of the longest day, which two last are in effect both one, for the further that any Parallel is situated from the Equinoctiall towards either of the Poles, the more Latitude it hath, & so by consequent maketh the day longer to those that dwell vnder that Parallel, of which Parallels the auncient Cosmographers do make in al but 21. procéding proportionally either towards the North pole or South pole, as you may sée by this figure here following, the middle line or Circle whereof is the Equinoctiall.



And euery Parallel proceeding from the said Equinoctiall, eyther Northwarde or Southwarde, doth lengthen the day by one quarter of an houre in such proportion as this table here following sheweth, appointing to the first Parallel, and nexte vnto the Equinoctial 4. degr. ℔ 1′5. and to the second parallel 8. degr. 3′0. and so forth vntill you come to the 21. parallel passing through Island, which parallel is distant from the Equinoctiall 63. degr. 1′6. further then which parallel Northward, the Tables of Ptolomie do not extend, and Southward they extend no further then to that parallel which hath lesse then 20. degrees of Latitude.

The Table of Parallels shewing how many degrees and minutes euery one is distant from the Equinoctial, made according to the rule of Ptolomy.

Parallels	D	M	Parallels	D	M	Parallels	D	M
the first	4	15	the eight	30	45	fifteenth	48	40
the second	8	30	the nynth	33	40	sixteenth	51	50
the third	12	45	the tenth	36	24	seuetenth	54	30
the fourth	16	35	eleuenth	39	0	eightenth	56	30
the fifth	20	30	twelfth	41	20	nineteenth	58	20
the sixth	24	15	thirteenth	43	15	twentieth	61	10
seuenth	27	30	fourteenth	45	24	the xxj	63	16

Of Clymes both old and new. Chapter. 18.

WHat is a Clyme?

A Clime is a space of the earth comprehended betwixt two Parallels, in which space the longest day doth vary by halfe an houre.

How many Climes be there?

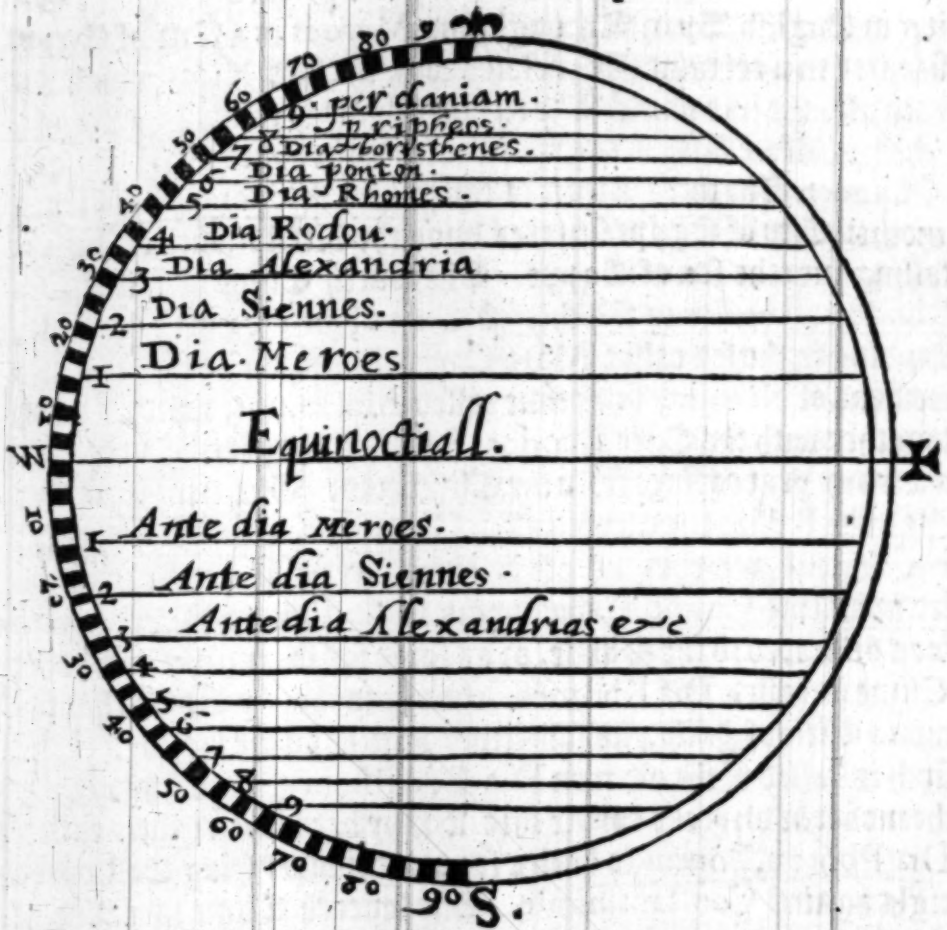
The auncient Cosmographers deuided aswel that part of the earth which lyeth betwixt the Equinoctiall and the North pole, so much I say as they thought to be habitable, as also the habitable part which lyeth betwixt the Equinoctial and the South pole, ech of them into 7. Climes, to euery of which Northern Climes they gaue a seuerall proper name, according to the name of the place through which the midst of ỳ said Clime did passe, for they called the first Clime Diameroes, Dia is a Greeke preposition signifying

ing

ing in English, By or Through, and Meroes is a City of Egypt situated in a certaine Ile enclosed with the flood Nilus, which Ile hath also the like name. The second Clyme is called Dia Sienes, 2
which is also a City in Egypt situated right vnder the Tropique of Cancer. The third Clime is called Dia Alexandrias, which is 3
another City of Egypt situated vpon the West mouth of Nilus, falling into the sea of Egypt. The fourth Clime is called Dia Rhodou, Rhodos is the chiefest Citie of an Ile called Rhodos, 4
standing in the sea called Mare Carpathium, washing the South west end of Natolia, sometime called Asia minor, which Ilande together with the Citie Rhodos, Suliman the great Turke wan not many yeares since from the Christians. The people of this Ile in S. Paules time were called Colossians, to whom hee wrote one Epistle, and they were so called of a great brazen Image called in Latine Colossus; containing in Altitude 105. fæte, which was dedicated to the Sunne, or as some say to Iupiter. The fift 5
Clime is called Dia Rhomes, that is to say, by Rome that famous Citie of Italy, and sometime head of all the worlde. The sixth is called of the old men Dia Boristhenes, notwithstanding 6
the moderne writers thinke that it may bee more rightly called Dia Pontou, Pontus is both a sea and countrey lying Eastwarde 7
right against Constantinople. The seuenth Clime is called of the old men Dia Ripheos, but of the moderne writers Dia Boristhenes, which is a great flood of Scithia in the South parte of Sarmatia, which falleth into the sea called Mare Euxinum. To these seuen Climes Appian addeth two others, so as in all he setteth down nine Climes, making the eight Clime to passe through 8.
Ripheos, which are mountaines enuironing Sarmatia on the North side, and the ninth through Denmarke. 9.

What names did they giue to the Southerne Clymes?

The selfe same that the Northerne Climes haue, sauing that they put before euery such name this Greek word Anti, which is as much to say as Contrary or Right against, as Anti Meroes, Anti Syenes, &c. as you may easily perceyue by this figure of Climes here following, notwithstanding none of those Southern Climes were knowne to Ptolomie more then Anti-Meroes, and hardly all that, the furthest part whereof hath not twenty degrées of Latitude.



And note that euery such Clime is deuided into 3. parts, that is the beginning, the midst, & the end. And if you would know what degrées and minutes of Latitude euery such part hath, that is to say, how many degrées euery such part is distant from the Equinoctiall, then consider wel this Table following, which both briefly and plainely sheweth the same.

	The beginning.		The midst.		The end.	
Degrees & minutes of houres.	D	M	D	M	D	M
The first Clime.	12	45	16	35	20	30
The second Clime.	20	30	24	15	27	30
The thirde Clime.	27	30	30	45	33	40
The fourth Clime.	33	40	36	24	39	0
The fift Clime.	39	0	41	20	43	30
The sixt Clime	43	30	45	24	47	15
The seuenth Clime.	47	15	48	40	50	30
The eight Clime.	50	30	51	50	53	10
The ninth Clime.	53	10	55	30	58	30

May not the North & South part of the world ech of them be deuided into more then 9. Climes?

Yes indéde as our latter writers affirme, for betwixt the Equinoctiall and the 66. degrée and 30. of Latitude in which the longeſt day containeth full 24. houres without hauing any night, they make 48. Parallels, and thereby 24. Climes, for euerye Clime containeth two Parallels, and euery Parallell maketh the day to increaſe by one quarter of an houre as hath béene ſaide before. But from thence forth, though you may continue the Parallels almoſt to the very Pole, yet you can make no more but 24 Climes by reaſon that the ſpaces of the Parallels towards either of the Poles, doe grow more narrow euery one then other, ſo as from 66. degrées and 30. minutes of Latitude vnder which the Circle Arctique paſſeth, the longeſt day is not to bee counted any more by houres, but by whole dayes, wékes, and monethes, in ſo much as they which dwell right vnder the North pole, whoſe Zenith is the pole it ſelfe, haue ſixe monethes day whilſt the Sunne abideth in the ſixe Northern ſignes, and 6. moneths night, the Sun being in the ſixe Southerne ſignes. And contrariwiſe they that dwell right vnder the South pole haue 6. months day, the Sunne being in the 6. Southerne ſignes, and 6. months night whileſt the Sunne remaineth in the 6. Northerne ſignes. But becauſe I thinke it a more ready way to account the length of the day by the degrées of Latitude, then by Climes or Parallels, I thought good here to ſet downe Orontius his Table made for that purpoſe, which from the 67. degrées of Latitude to the North pole agréeth in all pointes with the Table of Iohannes de Sacro Buſto, in which Table from the ſaid 67. degrée is not onely ſet downe the longeſt day, but alſo what portion of the Zodiaque alwaies appeareth aboue the Horizon, which portion when it containeth one whole ſigne, then the day is one month long, & the night as much, if two ſignes, then the day is two monethes long and the night as much, and ſo forth ſucceſſiuely vntil you come to 6. ſignes, which is the one halfe of the Zodiaque, making both day and night ech of them ſixe moneths long, as I haue ſaid before, and as you may plainely ſée with your eye by placing the Spheare on his Horizon at euery ſuch Latitude.

A Table shewing the longest day in euery degree of La-
North Pole, by whole degrees without minutes from one de-

Degrees of latitude	The longest day.			Degrees of latitude	The longest day.		
D M	H	M	S	D M	H	M	S
1 0	12	3	28	34 0	14	16	24
2 0	12	6	56	35 0	14	21	52
3 0	12	10	24	36 0	14	27	20
4 0	12	14	0	37 0	14	33	4
5	12	17	28	38	14	37	36
6	12	20	56	39	14	44	56
7	12	24	48	40	14	51	12
8	12	28	0	41	14	57	44
9	12	32	36	42	15	4	24
10	12	35	12	43	15	11	20
11	12	38	48	44	15	18	40
12	12	42	44	45	15	26	8
13	12	46	8	46	15	34	8
14	12	49	44	47	15	42	24
15	12	53	28	48	15	51	4
16	12	57	20	49	16	0	8
17	13	1	4	50	16	9	44
18	13	4	46	51	16	19	52
19	13	8	56	52	16	30	32
20	13	12	48	53	16	41	52
21	13	16	48	54	16	54	8
22	13	21	4	55	17	7	4
23	13	25	4	56	17	21	4
24	13	29	20	57	17	36	16
25	13	33	35	58	17	52	48
26	13	38	0	59	18	10	48
27	13	42	24	60	18	30	56
28	13	46	16	61	18	53	20
29	13	51	36	62	19	18	24
30	13	56	16	63	19	48	40
31	14	1	12	64	20	24	24
32	14	6	8	65	21	10	32
33	14	11	12	66	22	20	40

titude, proceeding orderly from the Equinoctiall to the gree to 90.

Degrees of latitude		The longest day			The arcs of the Zodiaque alwayes appearing above the Horizon		
D	M	Daies	H	M		De.	M
67	0	24	1	40		22	52
68	0	42	1	16		40	0
69	0	54	16	25		52	0
70	0	64	13	46		61	26
71		74	0	0		70	26
72		82	6	36		78	22
73		89	4	58		84	56
74		96	17	0		92	12
75		104	1	4		96	20
76		110	7	27		105	16
77		116	14	22		111	20
78		122	17	6		117	6
79		127	9	55		122	46
80		134	4	53		128	22
81		139	31	36		133	50
82		145	6	43		139	6
83		151	2	6		144	22
84		156	3	3		149	36
85		161	5	23		154	42
86		166	11	23		159	50
87		171	21	47		164	52
88		176	5	29		169	58
89		181	21	58		174	58
90		187	6	39		180	0

What things else doe the Cosmographers teach to be considered in Climes and Parallels?

Diuerse things, as first how many Italian miles euery clime hath in breadth and length, also what seasons of the yeare, and what shadows the sunne yeldeth to those that dwel vnder diuers Climes and Parallels.

What

What breadth and length do the auncient writers appoint to euery one of the seuen Climes.

They appoint such breadth and length as this Table following sheweth, in which also is set downe the degrées and minutes of Latitude through which the middle Parallell of euery Clime passeth, and also the number of miles answerable to one degrée of euery such Latitude.

Climes.	miles in breadth	miles in length.	The degrees and minutes of Latitude through which the midale parallell of euerie clime passeth		The number of miles answerable to one degree of euery such Latitude.
			De.	M.	
1	465	20555	16	37	57
2	420	19453	24	15	54
3	370	18398	30	45	51
4	350	17299	36	24	48
5	270	16215.	41	20	45
6	225	15136	45	24	42
7	195	14426	48	40	40

How is the breadth & length of euery Clime to be known.

The breadth is to bee knowne by multiplying the degrées of difference contained betwixt the beginning & end of euery Clime by 60. miles: And if the degrées of difference haue any minutes annexed thereunto, then you must adde so many miles as there be minutes, to the product of the former multiplication. Nowe to haue the length of euery Clime, you must séeke to knowe by the Table of miles, how many miles be answerable to one degrée of that Parallell of Latitude which passeth through the midst of the Clime, and by that number of miles multiply 360. and the product thereof shall bee the length. But if the degrées of that Latitude haue any minutes annexed thereunto, then you must finde out the miles of those minutes by the rule of proportion in saying thus: if 60. doe require so many miles as you founde in the Table of miles, what shall so many minutes require, and adde the quotient thereof to the product of the former multiplication, so shall you haue the true length of the Clime, all which thinges are obserued in the foresaid Table, which table by obseruing like

order

vnder, you may extend (if you will) to the number of 24. Climes, set downe by Orontius and by diuers other moderne writers.

Of the diuers seasons and shadowes incident to diuerse Climes and Parallels, and first what seasons and shadows they haue that dwell right vnder the Equinoctiall.

Cap. 19.

THose that dwel right vnder the first Clime and especially right vnder the Equinoctial, which people at one instant may see both the Poles, haue two sommers and two winters, for the Sun hauing to passe right ouer their heads twice in the yeare, which is when he is in Aries, and againe in Libra, then they must nedes haue two sommers, because the sunne at both those times is nighest vnto them, but when he is in Cancer or in Capricorne, then he is furthest frō them, and thereby maketh vnto them two Winters. But yet neither of them so cold as our winter is, wherby it appeareth that our two times of Spring and Autumne are to them 2. sommers and our two times of sommer and winter are to them two winters. 1. 2.

What shadowes haue those inhabitants.

They haue fiue sundrie shadowes, for when the Sunne is in either of the Equinoxes, they cast their shadow in the morning when the Sunne riseth towards the West. And at night when he goeth downe towards the East, and at noone day they haue no shadow at all, but a perpendicular shadow, which striketh right downe from head to foote, because the sunne being then in the Equinoctiall, must nedes at that time of the day be right ouer their heads, as you may plainely see in euery material Spheare, hauing a foote with a firme Horizon, and dewly placed to shew a right Spheare, but when the Sunne is in any of the Southerne signes, then the foresaid inhabitants doe cast their shadow towards the North, And when he is in the Northerne signes, they cast their shadowe towardes the South, and because they dwell in a right Spheare, their daies and nights be alwaies equall.

Of

Of the seasons and shadowes which they haue that dwel betwixt the Equinoctiall and the Tropique of Cancer.

Cap. 20.

THese haue also two sommers and two winters, and 5. shadowes like vnto the others because the sunne palleth twice in the yeare right ouer their heads, first in his declining from the Equinoctial towards Cancer, and againe in his returning from Cancer towards the Equinoctiall, vnder which Clime Arabia fœlix is said to be situated. For Lucan writeth that the Arabians comming to Rome to aide Pompey, marualled much to sée that the trées did neuer cast their shadowes on the left hand, because in their countrey their shadow is sometime on the right hand, and sometime on the left, sometime perpendicular, sometime oriental, and sometime occidental, but in Rome and in al other places beyond the Tropique of Cancer the shadow alwaies at noonetide tendeth Northward, the words of Lucan bée thus, Ignotum vobis Arabes veniltis in orbem, vmbras mirati nemorum non ire siniſtras.

How is Lucan to be vnderstood here in vsing this speach on the left hand?

As all other Poets are, for they hauing regard to the West, do alwaies make the North part their right hand, & the South part the left. But the Astronomers hauing regard to the south, do make the West their right hand, and the East their left hand: againe the Geographers contrariwise hauing regarde to the North, do make the East their right and the West their left hande, whereby you may sée that the right hand and left hand may be taken three manner of waies, that is according to the manner of the Poets, of the Astronomers, and of the Geographers.

Sith these inhabitants haue seasons and shadowes like to those that dwell right vnder the Equinoctiall, wherein then do they differ?

They differ in that their daies and nights be not alwaies equal, by reason that their Horizon declineth from the poles of the world, and by cutting the Parallels of the sunne with oblique Angles it deuideth those Parallels into vnequall partes, neither can their

two

two sommers bee so extreamely hotte as the others, because the Sunne for the most part is further from them.

Of the seasons and shadowes which they haue that dwell right vnder the Tropique of Cancer.

Cap. 21.

They haue but one summer and one winter, by reason that the Sun neuer passeth right ouer their heads but once in the yeare, and that is whē he entreth into the first degrée of Cancer: In which time when the Sunne ryseth, the shadow tendeth towards the West, & at noone the shadowe is perpendicular enclining on neither side, but falling right downe. And at night when the sunne goeth downe, the shadow tendeth towardes the East: and at all other times of the yeare the shadow at noonetide falleth alwaies Northward, & as touching their daies and nights, they shorten and lengthen according as the Sunne either approcheth towards Cancer, or retireth towards Capricorne.

Of the seasons and shadowes which they haue that dwel betwixt the Tropique of Cancer and the Circle Arctique.

Chap. 22.

They haue also one sommer and one winter as we haue here in England, for the sunne neuer passeth right ouer their heads, by reason that so soone as he hath made his last & highest Parallel in Cancer, he returneth againe Southward, and therefore their shadow is neuer at noonetide perpendicalar but shooteth Northward, and the daies and nights do lengthen & shorten according as the sunne maketh his course either through the Northerne or Southerne signes. For whilest hee passeth through the Northerne signes the daies are longer then the nights, and in passing through the Southerne signes hee maketh the nights longer then the daies.

Of

Of the seasons and shadowes which they haue that dwell right vnder the Circle Arctique, and how long their day is.

Chap. 23.

THey haue but one Winter and one Sommer, and their shadow alwaies tendeth sidelong & Northward. And because their Zenith being in the circle Arctique, is at all times of the yeare all one with the Pole of the Zodiaque: the Ecliptique line therefore must needes bee all one with their Horizon, whereby the one halfe of the Zodiaque in a very moment doth rise aboue the Horizon, and the other halfe in the same instant goeth downe, and as the whole Tropique of Cancer appeareth alwaies aboue the Horizon: So the whole Tropique of Capricorne is alwaies hidden vnder the Horizon, so as when the sunne entreth into the first degrée of Cancer, their day is 24. houres long & their night but a moment, so contrariwise when the sunne entreth into the first degrée of Capricorne, their night is 24. houres long, and their day but a moment, as you may plainely sée by placing the Spheare at the 66. degrée and 30. of Latitude.

What seasons, shadowes and length of day they haue that dwell betwixt the Circle Arctique and the pole Arctique.

Chap. 24.

THese haue like seasons and shadowes as those that dwell vnder the Circle Arctique, sauing that their Winter is colder and longer, because the nigher they approch to the Pole, the further are they from the Sunne, and also haue both longer dayes and nights, for the more that the Pole is eleuated aboue their Horizon, the greater portion of the Zodiaque doth alwayes appeare aboue the same, which portion if it containe one whole signe, then their daie is a moneth long, and their night as much, if two whole signes, then their day is two moneths long, and their night as much, and so forth as hath béene saide before.

Of

Of those that dwell right vnder the Pole.

Chap. 25.

WHat seasons, shadowes, and length of day haue they that dwell right vnder the Pole, if there be any such people?

Truely you doe well to doubt thereof, for in mine opinion humane nature is not able to suffer the extreme cold that by reason must needes be in those parts, neither doe I thinke that euer any man either Christian or Heathen did euer sayle so farre as to discouer any land there. Notwithstanding if ther be any such people their season is alwayes so extreme cold as no part therof is worthie to be called a sommer, but rather a continuall winter, and as for their shadow sith the Sun when he is at the highest doth neuer mount aboue their Horizon more then 23. degrees 30. at the most, their shadow must needes go round about them nigher, for the most part to their feete then to their heads, for the pole is their Zenith, and the Equinoctiall their Horizon, whereby 6. signes which is the one halfe of the Zodiaque, doth alwayes appeare aboue their Horizon, and the other halfe is alwayes hidden vnder their Horizon, and therby they haue 6. moneths day & 6. moneths night, day I say whilest the sunne is in the 6. Northerne signes, & night whilest the sunne is in the 6. Southerne signes, and yet the night can not bee so darke there as else where, by reason that the sunne is neuer distant from their Horizon aboue 23. degrees 30. which is onely when he entreth into the first degree of Capricorne. So likewise the day with them can neuer be so cleare as elswhere, by reason that the sunne mounting no higher aboue their Horizon then 23. degrees 30. which onely is when he entreth into the first degree of Cancer, hath no power to dissolue their grosse, thicke, cloudie and mistie aire, yet haue they some preheminence in that they may (if their cloudie aire be not the let) alwaies see all the fixed starres that are placed in the sky betwixt the Equinoctiall and the Pole, because they neuer go downe but are alwaies remaining aboue their Horizon: whereas in all other partes of the worlde, the said starres can not be seene all at once, for that they both rise and set, more or lesse in number according as the Zenith of the inhabitants of euery place is more or lesse distant frō the Equinoctiall.

By what names certaine inhabitants of the earth are called, as well according to the diuersitie or likenesse of shadowes as of situation.

Chap. 26.



You shall vnderstand that according to the diuersitie or likenesse of shadowes, the auncient Cosmographers haue giuen to the inhabitants certain Greeke names, wherof some are called Amphiscii, some Heteroscii, and some Periscii.

Shew what these names doe signifie.

Amphiscii bee those that cast their shadowes both wayes, that is sometime towardes the North, and sometime towardes the South, as those that inhabite the burnt Zone.

Heteroscii bee those that cast their shadow onely one way, as those that dwell in either of the temperate Zones, for if they dwell in the North temperate Zone, they do cast their shadow alwaies at noonetide towardes the North. And if they dwell in the South temperate Zone they cast their shadow at noonetide towardes the South.

Periscii are those that cast their shadow round about them as those that dwell in either of the colde Zones to whom the Pole is their Zenith: Againe they giue them certaine names according to the diuersitie or likenes of their situation and of the seasons incident to those places, whereof some are called Antœci, some Periœci, and some Antipodes siue Antichtones.

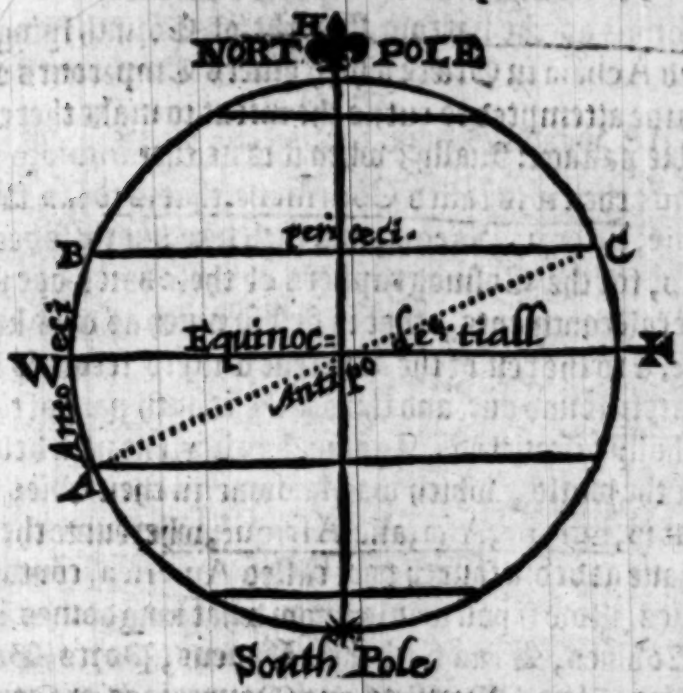
What doe these names signifie?

Antœci be two sundrie Nations, the one dwelling towardes the North pole, and the other towardes the South Pole, hauing one selfe Meridian and one selfe Latitude, that is to say be of like distance from the Equinoctiall, the one Southward and the other Northward, as the letters a. b. in the figure following do shew.

Periœci bee those that dwell in one selfe Parallel, how distant soeuer they be East and West as the letters b. c. in the said figure doe shew.

Antipodes bee those that dwell feete to feete, so as a right line being drawne from the one to the other, passeth through the Centre of the worlde as you may see by the Letters a. c. in the figure following.

And



And the first of these called Antœci haue contrarie seasons of the yeare, for when it is sommer to the one it is winter to the other: Againe Periœci, though they haue like seasons of the yeare, yet because they are so farre distant in length one from another, it is therfore mid-day to the one when it is mid-night to the other. But Antipodes be contrary in seasons and in all other things, hauing nothing common, more then that they haue one selfe Horizon.

By what names certaine parts of the earth are called by reason of their diuers shapes.

Cap. 27.

NOw besides the foresaid names attributed to the inhabitants of the earth for such respect as is aboue saide, the Cosmographers doe giue also to diuers parts of the earth according to the diuers shapes therof diuers names also: for if any part of the earth bee enuironed round with water either salt or fresh, it is called Insula, that is an Iland, as England, Ireland, and such like, but if the water goe round about it sauing in one part, then it is called peninsula, that is to say, almost an Iland, as Denmarke, Italy, Morea, and such like, and if it be a narrow straight enclosed with the sea on both sides, then it is

called Isthmus as the narrow straight of Corinth lying betwixt Boetia and Achaia in Græce which diuers Emperours of Rome haue in vaine attempted to cut, to the intent to make there through a nauigable passage: finally, when it is neither insula, peninsula, nor Isthmus, then it is called Continens, that is to say firme land, as Saxonie, Boemia, Suecia, and such like, but these bee speciall continents, for the Cosmographers of these daies doe make but three generall continents, that is first so much as was knowne to Ptolomie, & to the rest of the auncient writers, secondly the West Indies, lately found out, and thirdly the South part of the worlde not yet wholly discouered: Againe the auncient men deuided that portion of the world, which was knowne in their daies into three parts, that is, Europe, Asia, and Africque, whereunto the moderne writers haue added a fourth part called America, containing the west Indies. Now if you would know what kingdomes, Regions, Cities, Townes, Seas with their Hauens, Ports, Bayes, and Capes, Iles, Flods, Parishes, and Mountaines, are contained in euery one of these foure partes, then peruse often the vniuersall Maps, and Terrestriall Globes, as well of the moderne as of the auncient writers, and also the Tables of Ptolomie and of Ortelius, which I wish that they had bene made in such forme as the Tables of Ptolomie are: for hauing the North alwaies set in the front, it should be the readier to compare the shape or situation of any place or Region to the vniuersall Mappe, and by knowing the Longitude and latitude of any place, it should be the easier to find the same, as well in the speciall Tables as in the vniuersall Map or Globe. The vse of which vniuersall Maps, I haue already written in a seuerall Treatise by it selfe printed not long since. But now for so much as the knowledge of the windes hath bene alwayes thought a thing meete to bee treated of by him that writeth of Cosmography, and specially of the Spheare, I will here speake somewhat of them, neither do I mind to make any great discourse therof, as naturall Philosophers are wont to doe, but onely to define what the winde is, & to shew into how many parts the same is deuided, as well by the auncient as moderne writers, and by what names they are called and somewhat of the qualities thereof.

Of

Of the winde, what it is, what motion it hath, and of the diuers names and diuisions thereof.

Cap. 29.

FIrst then you haue to vnderstand that Aristotle and the rest of his sect, doe define the wind to bee an exhalation hotte and dry, engendred in the bowels of the earth, and being gotten out, is caried sidelong vpon the face of the earth.

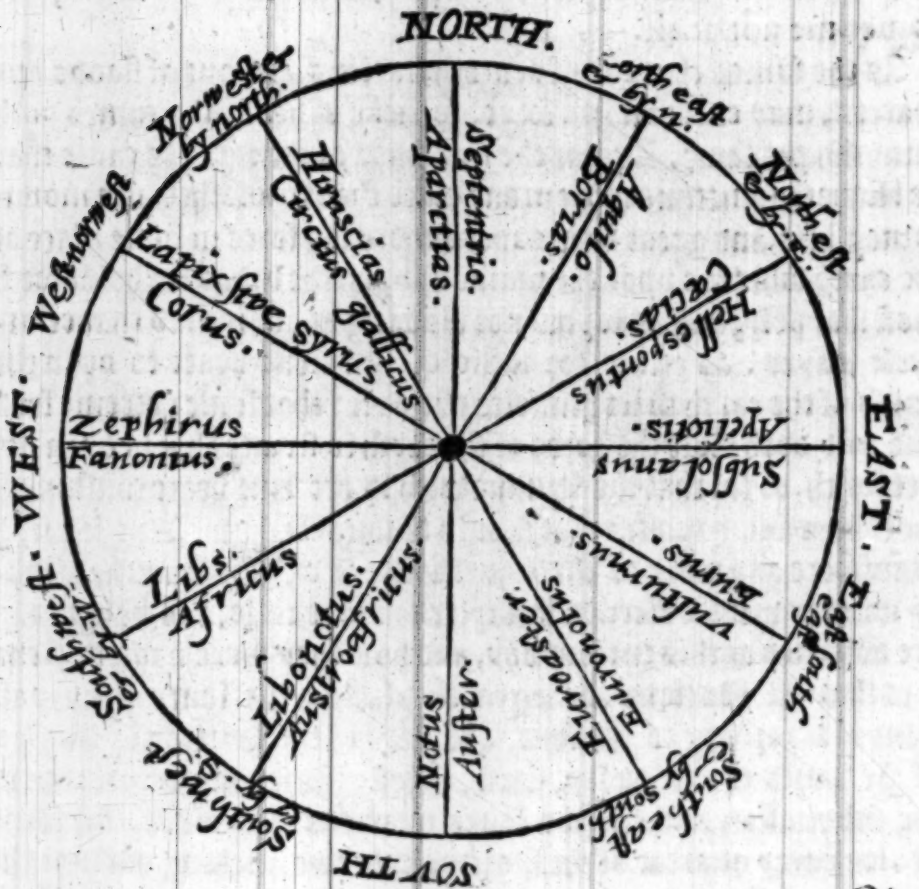
Why is not his motion right vp & down, aswell as sidelong?

Because that whilest by his heat he striueth to mount vp, and to passe through all the three Regions of the aire, the middle Region by his extreme colde, doth alwaies beate him backe, so as by such strife & by the meeting of other exhalations rising out of the earth, his motion is forced to be rather round then right.

What is the cause why hee bloweth more sharpely at one time then another, and in one place more then another, and sometime not at all.

As the fumes that rise of new exhalations, and out of flouds and waters, may encrease his force, so lacke of heate and fumes doth diminish the same. Againe the roundnes of the earth is cause that he bloweth sometime more in one place then in another: also mountaines, hils, and great woods may hinder his force in some place of the earth whereas vpon the plaine or vpon the broad sea he bloweth most sharpely, and as for his not blowing at all, it may chance diuerse wayes, as either for lacke of sufficient heate to open the pores of the earth to let himselfe out, or for that some extreme frost and cold doth close the pores of the earth so straite that hee can not get forth, or for that the Sunne with is extreme heate consumeth the fumes and vapours that should maintaine him. But leauing to answere any more to these questions, I will shew you how many windes were obserued by saylers in olde time, and how many are obserued at this present day, and how they were named. True it is that all Nations doe agree in placing the foure principall winds, according to the foure quarters of the Horizon or Angles of the world, that is to say, East, West, North and South: but in the subdiuision of the sayde foure quarters they differ, for some deuide euery quarter of the Horizon into two, making onely eight winds, and some into three, and thereby do make 12. winds which

the auncient Grækes and the Romaines did chiefely obserue, the names of the 8. winds are commonly expressed in the Italian tong thus: Thramontano, North, Mezzodi, South, Leuante, East, Ponente, West, Griego, Northeast, Garbino, Southwest, Maistro, Northwest, Syrocco, Southeast, which names are often vsed by Christopher Columbus, Albertus Vesputius, and others that sayled first into the East and West Indies, and if you will know the names of the 12. windes vsed by the auncient Grækes and Romaines, then beholde this figure heere following wherein you shall find them set downe in English, Græke, and Latine, that is to saye, the English names without the Circles, and the Greeke and Latine names within the Circle, the Græke vppon the right side of euery line pointing the winde, and the Latine name vppon the left side of euery such line.



Ot

Of the nature and qualities of the foresaid 12. windes.

Chap. 29.

THe North wind called Septentrio or Aparctias is extremely colde and dry, prohibiting raine, it preserueth health by cleansing the Aire of all pestiferous infections, but it causeth drie coldes, & hurteth the fruites and floures of the earth.

2 The Northeast and by North, called Aquilo or Boreas, is also cold and dry without raine, it hurteth ỹ flowres and fruits of the earth, and especially the Vines when they bud.

3 The Northeast and by East, called Helispontus or Cæcias, is hotte drying vp all things.

4 The East winde called Subsolanus, is hotte and dry, temperate, swéte, pure, subtill, and healthfull, and specially in the morning when the Sunne riseth, by whom he is made more pure and subtill, causing no infection to mans body.

5 The East Southeast, called Eurus or Vulturnus, is also hotte and dry, he bloweth lowde, and therefore is called of Lucretius, Altitonans vulturnus.

6 The Southeast and by South called Euroauster or Eronotus, is hotte and moyst, and brédeth clouds and sicknes.

7 The South wind called Auster or Notus, is hotte and moist brédeth thicke cloudes, great raines, and pestiferous aire.

8 The Southwest and by South, called Austro aphricus, is temperately hotte, & yet brédeth sicknes and raine as some write.

9 The Southwest and by West named Aphricus or Libs, is colde and moyst causing raine.

10 The West winde called Fauonius or Zephirus is temperately hotte and moyst, and wholsome in the Euening, it dissolueth frost, yce, and snow, and maketh flowres and grasse to spring, and some write that it causeth Thunder.

11 The West Northwest, called Corus or Syrus, is cold and moyst without any great rigour.

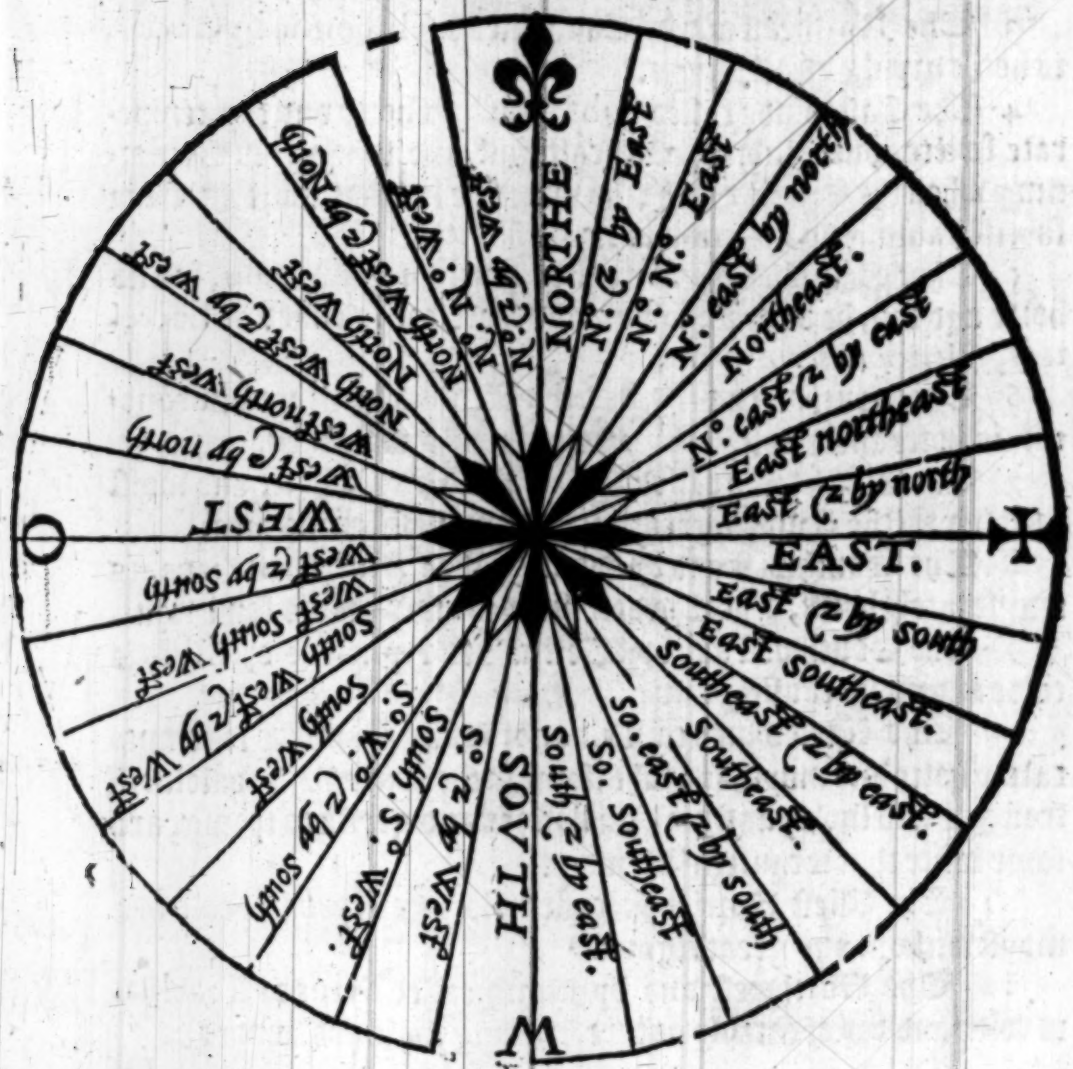
12 The Northwest and by North called Syrus or Trachias is colde and dry of earthly nature, breeding snow and windes.

Of the moderne deuision of the windes.

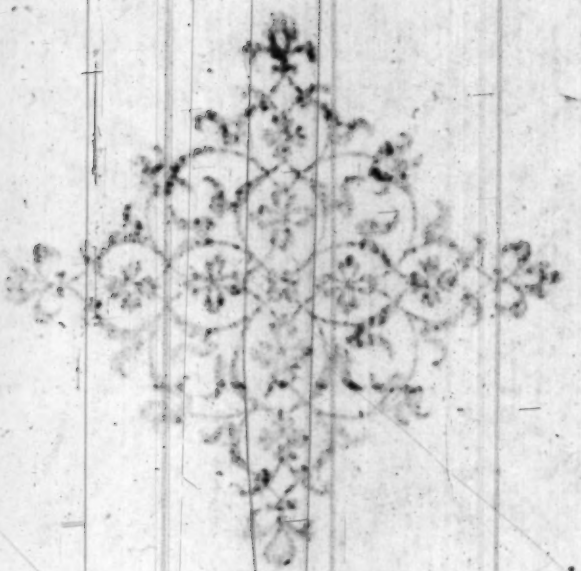
Cap. 20.

BVt the Mariners of these our latter daies, to bee the better assured of their routes and courses on the sea, do deuide euery quarter of the Horizon into 8. seuerall windes, so as they make in all 32. windes, which of the Spaniards are called Rombes, which winds together with their names, you may see plainely set forth in this figure following representing the Mariners Compasse.

A figure of the 32. windes representing the Mariners Compasse.



And note that eight of these winds are called principall winds, that is North, South, East, West, Northeast, Southwest, Northwest, and Southeast, and all the rest are called Collaterall windes, but the first foure are chiefest, from whence the names of all the rest are deriued, neither doe the learned Pilots in their Tables, call the first foure windes, Rombes, but will say the first, seconde or third Rombe from North, from East, South, or West, vnto the number of seuen, for so many Rombes they make in euerye quarter betwixt the foure chiefe and principall windes, of which matter I shall speake hereafter in my treatise of Nauigation. In the meane time I heartily pray all those that shall vouchsafe to reade this my treatise of the Spheare, to take my labour therein bestowed in good part, and where any fault is, friendly to correct the same without any skorne or disdaine.



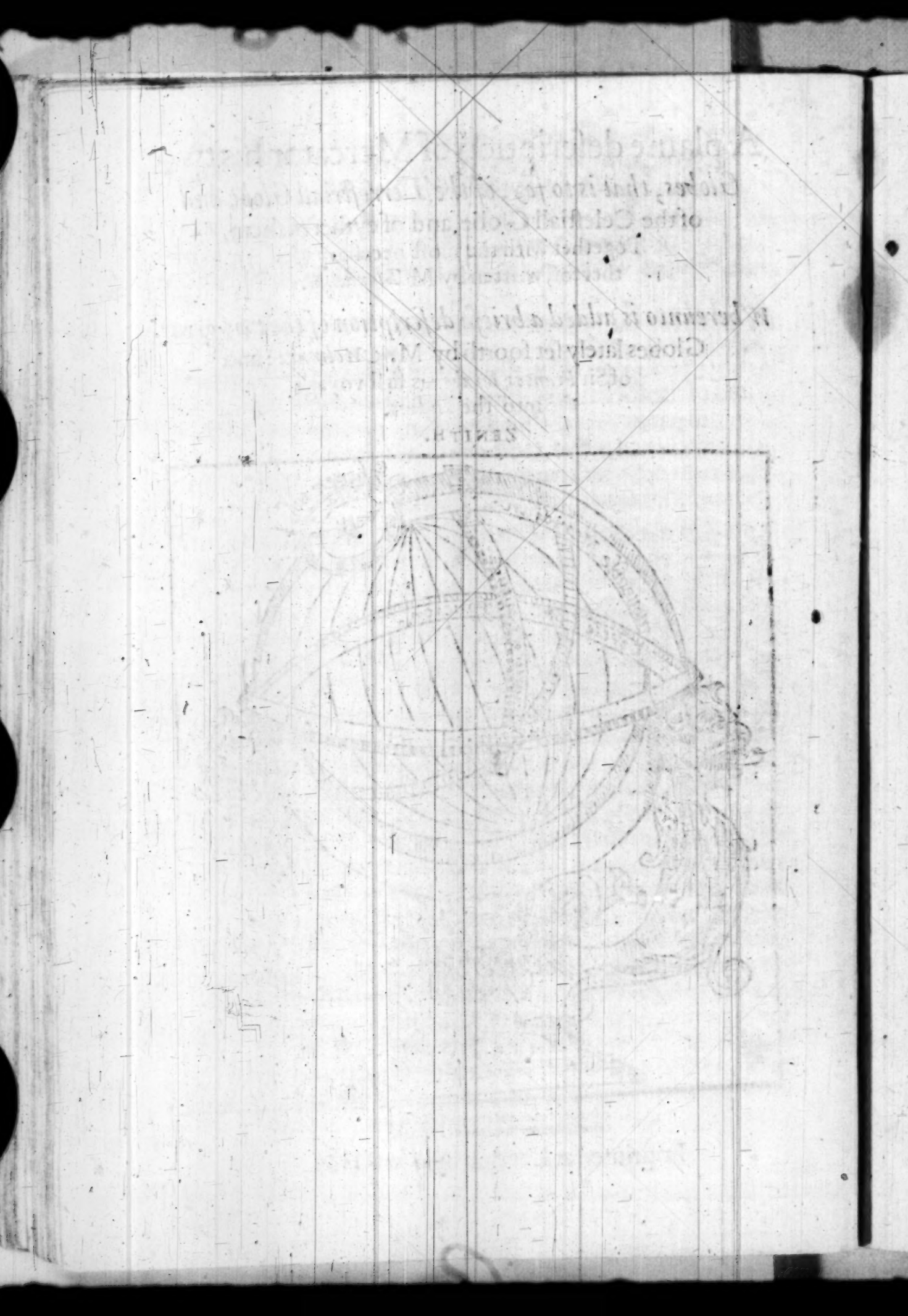
A plaine deſcription of Mercator his two *Globes, that is to ſay, of the Terreſtriall Globe and* of the Celeſtiall Globe, and of eyther of them, Together with the moſt neceſſary vſes thereof, written by M. *Blundeuill.*

Whereunto is added a briefe deſcription of the two great Globes lately ſet foorth by M. *Molinaxe*: and of Sir *Frances Drake* his firſt voyage into the Indies.



He telleth the number of the ſtarres and calleth them by their name. Pſal. 147.

Imprinted at London by *Iohn Windet.*



A plaine deſcription of the two Globes *of Mercator, that is to ſay, of the Terreſtriall Globe,* and of the Celeſtiall Globe, and of either of them, together with the moſt neceſſary vſes thereof and firſt of the Terreſtriall Globe, written by *M. Blundeuill.*

The Terreſtriall Globe is a round body couered with an vniuerſall Map contayning both ſea and land, which is deuided by the later Coſmographers into foure principall parts, that is, Europe, Affrique, Aſia, and America, the Longitude and Latitude of euery which part is alreadie ſet down in my deſcription of vniuerſal Maps and Cardes. And in this Globe are alſo ſet downe certaine ſtars, ſome towards either of the poles, & ſome nigh to the Ecliptique line, whereof we ſhall ſpeake hereafter when we come to treate of the Celeſtiall Globe. But you haue to vnderſtand that the one end of this Globe is called the pole Arctique, that is to ſay, the North pole, and the other ende the pole antarctique, that is to ſay, the South pole: vppon which two poles it is turned about. And this Globe is traced with certaine circular lines, whereof ſome bee greater and ſome leſſer, thoſe greater which paſſe through both the poles, are called Meridians of this word Meridies, which is as much to ſay as none tide, for when the Sunne toucheth any of thoſe Circles, it is noonetide to all thoſe that dwell right vnder that Circle, of which Meridians though you may imagine to bée halfe ſo many as there bee degrées in the Equinoctiall, which amounteth to the number of 180. yet there are ſet downe in this Globe no more but twelue which doe cut the Equinoctiall in 24.

points,

points, making thereby 24. spaces, euery space containing 15. degrées of the Equinoctiall, which fifténe degrées doe make one houre, for ỳ Equinoctial is a great circle which guirding the globe in the very middest betwixt the two Poles, and representing the motion of the first moueable, maketh his dayly reuolution from East to West in foure and twentie houres. And this great Circle by deuiding the Globe into two equall parts, causeth the same to haue two Latitudes or breadthes, the one Northerne and the other Southerne, for that space of the halfe Globe which lyeth betwixt the Equinoctiall and the North Pole, is called the North Latitude, and the other halfe of the Globe which lyeth betwixt the Equinoctiall and the South Pole, is called the South Latitude, ech Latitude containing euerie where from the Equinoctiall to either of the Poles nintie degrées. Againe this Circle is deuided into 360. degrées containing the whole Longitude of the earth, and euery degrée is 60. Italian miles, which being multiplyed into 360. maketh in all 21600. miles, and such Longitude is to be counted from West to East, beginning the same at the first Meridian which passeth through the Iles of Canaria, otherwise called Insulæ fortunatæ, crossing the Equinoctiall and the Ecliptique line, in the first degrée of Aries, and also in the first degrée of Libra, which are the two Equinoctiall points, so as the one halfe of the Equinoctiall which goeth from West to East, contayneth 180. degrées, and the other halfe returning againe from East to West contayneth also 180. degrées, which maketh in all 360. degrées, ending where the first degrée of Longitude did beginne: For though Mercator and others in their seuerall Maps doe in these dayes make the first Meridian to passe through the Iles Azores which are fiue degrées more to the West. Yet Mercator in his great Terrestriall Globe dedicated first to the Lord Granuella, and afterwards to the Emperour Charles the fift, Anno Domi. 1541. placeth the first Meridian as before is sayde, both whose Globes my Worshipfull friend Sir Thomas Knyuet of Ashwelthorpe Knight, did courteously lend me I thanke him, who as he is verie well learned in all the liberall Sciences himselfe, so is he a great fauourer and furtherer of all such as delight in anye learned or vertuous exercise: And by helpe of those Globes I wrote

this

this Treatise. But to returne to my matter, there is another great slowping and ouerthwart Circle, called the Ecliptique line, vnder which the Sunne continually walketh, and this line is marked with the Characters of the twelue signes, euery signe containing in length thirtie such degrées as the Equinoctiall hath, so as in all, the Ecliptique line containeth 360. degrées, which is the Longitude of heauen, and the first degré of the Longitude of any Carre beginneth at the first point of Aries, and endeth at the same point. Now of the lesser Circles there be foure principall, that is, the two Tropiques, that is to saye, the Tropique of Cancer towards the North pole, and the Tropique of Capricorne towards the South pole, betwixt which two Tropiques, ỳ Sun continually goeth right vnder the foresaid Ecliptique line, neuer mounting higher then the Tropique of Cancer, nor descending lower then the Tropique of Capricorne. Of the other two lesser Circles, the one is called the Circle Arctique enuironing the North Pole, and the other the Circle Antarctique enuironing the South Pole: all which foure Circles are called Parallels, that is to saye, equally distant one from another, and by reason of these foure Circles, the Globe is deuided into fiue Zones, that is to saye, two colde Zones, two temperate, and one extreamely hotte: of the colde Zones, the one lyeth betwixt the Circle Antarctique, and the South pole, and the other betwixt the Circle Arctique and the North pole.

And of the temperate Zones, the one lyeth betwixt the Tropique of Cancer and the Circle Arctique, and the other lyeth betwixt the Tropique of Capricorne and the Circle Antarctique. The hotte Zone is that which lyeth betwixt the two Tropiques, through the middest of which Zone passeth the foresayde Equinoctiall line, right vnder which, they that dwell, haue no Latitude at all, and therefore their dayes and nightes are alwaies equall, (that is to say) twelue howres day, and twelue houres night. Also besides these foure foresaide lesser Circles or Parallels, the Globe is traced with eight other Parallel Circles on the each side of the Equinoctiall towardes either of the poles, making on each side nine equall spaces, euery space containing ten degrées of the Equinoctiall, so as they doe make in all 90. degrées, which is a

quarter

quarter of the great Circle. Moreouer there bee certaine Mariners Compasses deuided into 32. Circular lines signifying the 32. windes, whereby Mariners doe saile, and do direct their ships from port to port, which lines doe diuersely crosse the other Circles before rehearsed. Besides these circular lines before described, there is fastned vnto the two poles of the Globe, a Meridian of brasse cõmonly called the mooueable Meridian within the which the Globe turneth about, and this Meridian is deuided into foure quarters euery quarter containing 90. degrées, so as the whole circuit thereof is 360. degrées, one of which quarters towards the North pole is deuided with circular lines into three seuerall spaces, in the first and lowest whereof being next to the body of the Globe, are set downe the numbers of degrées of Latitude. In the next space aboue that, are grauen the Parallels and numbers of houres of the longest day in euery Latitude, and the spaces of euery houre are deuided with little strékes into foure parts, signifying the foure quarters of an houre: and these houres doe encrease till you come to 24. houres, and from thence the daye increaseth by monethes, from one to sixe, ouer which is grauen this Latine word Menses, (that is to say) monethes, and the thirde and vppermost space containeth the Climes, beginning at one, and so procéedeth to 8. The like Climes, Parallels, and houres of the longest day, are to be accounted also in the said Brazen meridian procéding from the Equinoctiall towards the South pole, though they be not there set downe. And vpon this Brazen Meridian is placed at the North pole another little Brazen Circle, together with his Inder called the houre whéle, euery halfe wherof contayneth twelue houres, the Inder of which whéle being set vppon the North pole turneth about as the Globe turneth, and yet you must imagine the Pole it selfe to bee immooueable. Also there is a quarter Circle of thinne Brasse plate, deuided into 90. degrées fastened in such sort vppon the Brazen Meridian, as you may remoue it to and fro, yea and also take it cleane offif you will, which quarter Circle hath a square head of brasse, signifying the Zenith or verticall point of any place, and this Circle is called the quarter of altitude, which quarter is deuided into 90. degrées, procéding from the Horizon vpward to the Zenith, where-

by

by may bee described vpon the Globe the 90. Almicanterathes or Circles of Altitude. And this quarter serueth for diuers purposes, as to find out thereby the altitude of any starre or point of the Ecliptique line, or of any other point in heauen, and the verye edge thereof on the right hand, sheweth the Azimuth or verticall Circle of any place, and in what coast and part of heauen any star is. Also how any place of the earth beareth one from another as you shall more plainly perceiue hereafter by the examples of certain propositions thereto belonging. Then there is another Circle of brasse plate somewhat thicker called the semi-Circle of position, which serueth chiefly for matters of Astronomie, as to find out the twelue houses of heauen, and is to be fastned on the Horizon, so as it may be remooued and set vppon which side of the Globe you will. Also there belongeth to the Globe a little round squire of brasse, made with right Sphericall Angles, the head or stile whereof is to shew the shadow of the Sunne being set vpon the Globe, in stead wherof a needle being set right vp, will sometimes serue the turne. Finally to the Globe belongeth another circle called the Horizon, which is a broad Circle of wood hauing a foote of woode, within which Horizon, the Globe together with the brazen Meridian is to bee set at what altitude you list. And this Horizon is diuided with diuers circular lines into seuen vnequall spaces, wherof the first and narrowest space next vnto the body of the Globe, containeth the degrées of the 12. signes of the Zodiaque, euery signe containing 30. degrées. The second space containeth the Characters & names of the saide signes, & also the number of the degrées, as 10. 20. 30. The third the dayes of euery moneth. The fourth the names of euery month, and of certaine Festiuall dayes. The fift, the names of the twelue winds, which the auncient Grekes and Romaines were wont to obserue, whereof I haue already spoken in my Spheare. The sixth and seuenth doe shew the 12. houses, together with their significations necessary for the setting of figures and calculating of natiuities, and in the foote of the said Horizon is a little Compasse with a needle to shew the North & South, according to which the Globe is to be placed. But yet not before the said needle bee truely rectified, according to the variation which it hath in that place where you are to vse the Globe: for otherwise the needle may cause great

erroꝛ, whereof you ſhall treate in the next Chapter. Thus hauing briefely deſcribed the Terreſtriall Globe, and all the parts thereof, I thinke it good now to ſhew you how to place the Globe accoꝛding to the foure quarters of the woꝛld.

This Treatiſe of the two Globes, containeth 50. *Propoſitions as followeth.*

HOw to place the Globe truely, according to the foure quarters of the world, and according to the Latitude of any Region. Propoſition. 1.

To know vnder what Clime any place or Region is, and how many houres the longeſt day is there, and alſo what Latitude any place deſcribed in the Mappe hath. Propoſition. 2.

How to know what Longitude any place deſcribed in the Mappe hath. Prop. 3.

How to know the diſtance betwixt any two places deſcribed in the Mappe. Prop. 4.

To know how one place beareth from an other. propo. 5.

How to finde out by the Globe the place of the Sunne, that is to ſay, the degree and minute of that ſigne wherein the Sun is euery day throughout the yeare. Propo. 6.

How to rectifie the Index of the houre-wheele for euery ſeuerall day throughout the yeare. Prop. 7.

How to know euery day at what houre the Sunne riſeth or ſetteth. Prop. 8.

How to know in what part of the Horizon the Sunne riſeth and ſetteth euery day. Prop. 9.

How

How to know the length of euery day and night throughout the yeare as well by helpe of the houre-wheele, as by counting the degrees vpon the Horizon. Prop. 10.

How to know by the Globe how much the Sun declineth euerie day throughout the yeare from the Equinoctiall. Propoſition. 11.

How to knowe by the Globe the Meridian altitude of the Sunne, that is to ſay, his height at noone tide euery day throughout the yeare, and how far hee is then diſtant from your Zenith. Prop. 12.

How to know the altitude of the Sun at euery other houre of the day. Prop. 13.

How to know the houre of the day by the Globe. Propoſition. 14.

To know how much the vnequall howres otherwiſe called the Planetarie houres, doe differ from the artificiall houres throughout the yeare, and how many minutes euery vnequall houre containeth. Prop. 15.

How to know euery day when the dawning of the day, and the twilight of the night beginneth and endeth, and the time of their continuance. Prop. 16.

How to know the aſcention of the Sunne, both right and oblique. Prop. 17.

The 18. propoſition, containing the deſcription of the Celeſtiall Globe, and ſhewing wherein it is like or differing from the terreſtriall Globe.

The 19. propoſition containing a particular deſcription of the 48. Images of the fixed ſtarres that are in the Celeſtiall Globe, together with their ſundrie names, and alſo the names of ſo many ſtarres as are named in the Globe. Prop. 19.

How to finde out in heauen any vnknowne ſtarre deſcribed in the Globe two manner of waies, that is, either by the helpe of ſome knowne ſtar, or elſe by knowing the true houre of the night. Prop. 20.

How to knowe by the Globe the Meridian altitude which is the higheſt altitude of any ſtarre, and alſo how high or low he is at any other time. Prop. 21.

How to know by the Globe what ſtarres are aboue the Horizon at any time of the day or night. Prop. 22.

How to know by the Globe at what time any ſtarre ryſeth aboue the Horizon, mounteth to the higheſt, and ſetteth, and with what degree of the Ecliptique hee ryſeth, mounteth, and ſetteth: and alſo in what part of the *Horizon* he riſeth and ſetteth. Prop. 23.

How to know in what part of the firmament, any ſtar is, and how many degrees it is diſtant frō the Meridian at any houre, and being right vnder the Meridian to know how far it is diſtant from your Zenith. Prop. 24.

How to find the houre of the night by the Globe. Prop. 25.

How to know the verticall ſtars in euery Latitude. *Prop*, 26

How to know the true place of any ſtar, that is to ſay, in what ſigne and in what degree thereof any ſtar is. Prop. 27.

How to finde the place and Longitude of any ſtarre by the Globe. Prop. 28.

How to find out the Latitude of any ſtar. Prop. 29.

How to find out by the Globe, the declination of any ſtar: Prop. 30.

How to know the magnitude or greatnes of any ſtar, and his nature and qualitie by the Globe, and alſo the right aſcention of the Arque of the Ecliptique, which accompanieth the right aſcention of any ſtar. Prop. 31,

A Table of the fixed ſtarres.

How to find out the right and oblique aſcention of any ſtar and alſo of the aſcentionall difference. Prop. 32.

To know in what quantitie of time any whole ſigne or any other Arque of the Ecliptique doth riſe or ſet. Prop. 33.

How to know by the Globe what ſtars doe riſe or ſet euery day Coſmically, Acronically, or Heliacally, Prop. 34.

To know in what time of the yeare any ſtar riſeth or ſetteth, ether Coſmically or Acronically. Prop. 35.

Of the Horoſcope and the reſt of the 12. houſes. Prop. 36.

How to find out the Horoſcope or aſcendent at any time of the day or night by the Globe, and thereby to know the foure principall Angles of heauen. Prop. 37.

How

How to erect a figure by the globe according to *Regio Montanus* his way, which is called the reaſonable way, and is counted the beſt of all others. Prop. 38.

How to know the Latitude of any place or region by any of the fixed ſtars deſcribed in the Globe. Prop. 39.

Another way to find the eleuation of the Pole. Prop. 40.

A third way how to find out by 2. ſtars the eleuation of the pole, not knowing their Meridian altitude. Prop. 41.

A fourth way to find out the Latitude of any Region by any knowne fixed ſtarre or *P*lanet that may be ſeene. Prop. 42.

A briefe deſcription of the diurnall Table ſet down in *Stadius* his Ephemerides, together with the vſe thereof. Prop. 43.

How to finde out the place of any planet by the Ephemerides. Prop. 44.

A briefe deſcription of the Table of *Stadius*, ſet downe in the 112. Page of his Ephemerides, to finde out thereby the dayly Latitude of the Moone be it North or South, together with the Cannon or rule thereof, plainely declared by example. Prop. 45.

How to know the true place of the Sunne or Moone or of any other *P*lanet euery houre of the day throughout the yeare Prop. 46.

How to find out the place of the Moone by the Globe when ſhe is aboue the Horizon, without the helpe of any Ephemerides or other Table whatſoeuer. Prop. 47.

Another way to finde out the place of the Moone without taking the latitude of any ſtarre. Prop. 48.

How to find out the Longitude of any region. Prop. 49.

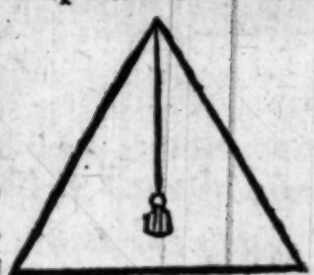
Another way to find out the vnknowne Longitude of anye place by the Globe. Prop. 50.



How to place the Globe truely according to the foure quarters of the world, and according to the Latitude of any region.

The 1. Propoſition.

FIrſt in bedding your Globe together with the Brazen Meridian in the two nickes of the Horizon and alſo in the ſlit of the pinne which ſtandeth in the middeſt of the foote, ſo that the North pole of your Globe bee anſwerable to the North quarter or North wind of the world, deſcribed vpon the Horizon, and ſée that that part of the Brazen Meridian, wherin are deſcribed ẏ Clymes, Parallels and houres of the longeſt day, may ſtand aboue the Horizon, and alſo that the one halfe of the brazen Meridian may iuſtly and euenly appeare aboue the Horizon, and the other halfe vnder the Horizon: Againe, you muſt ſée that the Equinoctiall line of the Globe doe méete iuſt with the middle point or ſtreeke of the brazen Meridian whereas the firſt degree of Latitude doth begin, and alſo that the body of the Globe doe not leane to the one ſide of the Horizon more than to the other, but to be equally diſtant from the ſame in al places, and in any wiſe to ſee that the Horizon ſtand alwaies leuel, to which end ſome Globes haue a plummet of leade hanging by a little chaine or threéde, which



becauſe it will moue with euery wind, I for my part do thinke it better for you to haue ſuch a little leuell made of purpoſe, as you may ſet the ſame vpon any place of the Horizon wher you liſt, & thereby make the Horizon to ſtand leuell on euery ſide as you wil

your

your selfe, and it may be made of a little peece of thicke boorde, like a Triangle, thus.

Then with your two hands laying hold of the two next pillers, turne the foote of the Globe vntil it stand right North and South, which is to bee done thus. First finde out the true Meridian of the place whereas you are to vse the Globe by such meanes as Master Burrough teacheth in his discourse of the variation of the Compasse, the 7. Chapter, which vndoubtedly is a most certaine way, by which you shall finde three thinges at one instant, that is, the true Meridian, the variation of the needle, and the true Latitude of any place. But if you haue not the instrument of variation, by helpe whereof this matter is to bee accomplished, then in some open place betwixt 8. and 9. of the clocke in the forenoone or sooner, vpon a smooth Table or plancke, standing leuell, drawe a good large Circle with your Compasses, in the Center whereof must bee fired a round and straight pinne of Iron or Latton wyer, in length a good deale shorter than the Semidiameter of that Circle, and to the intent that the pinne or stile may stande right vp, without inclining on either side, it would be rectified by a true Squire: That done, waite diligently vntill the shadow of the pinne heade doe iustly touch the circumference of the Circle, so as it neyther passe beyond the Circle, nor come short of the same, and there make a pricke, and so let it stay vntill about three of the clocke in the afternoone, about which time the shaddow of the pinne will beginne to approch nigh vnto the saide Circle, and so soone as it toucheth the same, make there another pricke: that done, deuide the Arke or portion of the Circle, contained betwixt those 2. pricks into two equall parts, and in the midst thereof set another pricke, then laying your ruler to the middle pricke, and to the Center of the Circle, draw a right line throughthe Center and also through the middle pricke from the one side of the Circle to the other, and beyond if you list: for you may make the saide line of such length as you shall thinke most meete to serue your turne, and that line shall be the true Meridian for that place, shewing the right North and South parte of your Horizon, and by crossing the saide line with another right line in the verie middest with right Angles, you shall haue the true East and West, and to auoyde long wayting, you may draw diuerse Circles one with in another. Thus ha-

uing found the true Noꝛth and South, East and Weſt, place your Globe accoꝛdingly, ſo as the Bꝛazen Meridian of the Globe may aunſwere the Meridian line alreadie dꝛawne vpon the boꝛde oꝛ plancke, and to the intent that afterward you may knowe at all times both day and night, how to place your Globe right Noꝛth and South, it ſhall be neceſſarie to dꝛawe a right line vppon the foote of the Hoꝛizon, anſwerable to the foꝛeſaide Meridian firſt dꝛawne vpon the booꝛde oꝛ plancke, and vpon that line to faſten a pꝛetie handſome Compaſſe, hauing a nædle of an inch long at the leaſt, which is much moꝛe certaine, than ſuch a little nædle as is woont to bee ſet in the foote of euerie Globe: And when the nædle ſtandeth ſtill, marke how much the Noꝛth point thereof declineth eyther Eaſt oꝛ Weſt from the true Meridian befoꝛe taken, and whereas you ſée the Nædle to decline, bée it Eaſt oꝛ Weſt, there ſet faſt a little pinne of Latton to ſerue as a marke, whereto you may alwayes diꝛect the Noꝛth point of the nædle when you would haue the Globe to ſtand right Noꝛth and South, foꝛ there is no nædle touched with the loade ſtone, bee it neuer ſo good a ſtone, but it will varie from the true Meridian line, either moꝛe oꝛ leſſe, and theꝛefoꝛe no truſt is to bee giuen to the nædle vntill you know the true variation thereof, the finding of which variation, as I ſaid befoꝛe, is moſt truely taught by M. Borough in his Booke befoꝛe mentioned, whereunto I once againe refer you, and the rather foꝛ that it is wꝛitten in our mother tongue. But Gemma Friſius teacheth to ſet the Globe right Noꝛth and South thus, firſt goe into an open place whereas the Sunne ſhineth, and vpon ſome Table ſtanding leuel, and alſo the Globe ſtanding leuell, the Pole being eleuated aboue the Hoꝛizon accoꝛding to your Latitude, fixe a right nædle in the degrée of the ſigne, wherein the Sunne is that day, ſo as the nædle may ſtand right vpp without inclining any manner of way, and if it bee in the foꝛenoone, turne the Eaſt ſide of the Globe towardes the Sunne, mouing both the Globe and his ſeate to and fro, vntill you ſée the nædle to caſt no ſhaddowe at all, foꝛ ſo ſhall the Globe ſtande right Noꝛth and South. But if it bee in the afternoone, you muſt turne the Weſt ſide of the Globe towardes the Sunne, and then woꝛke as befoꝛe, and by any of theſe wayes beforе taught you ſhall noꝛ onely place

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the Globe answerable to the foure quarters of the world, but also you shall find that the Circles, Poles, and Axletrées of the Globe, are answerable to the Circles, Poles, and Axletrées of the heauens. Now hauing placed your Globe aunswerable to the fower quarters of the world, learne to know by some Table or moderne Map, or else by such wayes as are set downe both in my Spheare, and also in the latter end of this Treatise, the Latitude of the Region wherein you dwell: As for example, the Latitude of these partes here about Norwich is 52. degrées, then taking holde of the Brazen Meridian as well with your left hand aboue the Horizon, as with your right hand beneath the Horizon, turne the same vp and downe in the nickes of the Horizon, vntill the North Pole be eleuated aboue the Horizon 52. degrées, the last of which degrées must méete euen with the vpper brimme of the Horizon, that done, seeke for England in the Globe, not leauing to turne the body of the Globe to and fro vntill you haue brought that Meridian which passeth through England right vnder the Brazen Meridian, and holding it still at that stay, drawe the heade of the Brazen quarter of altitude right ouer the place, and ouer that Meridian vnder which you dwell, so shall the head of your Brazen quarter stand for your Zenith in the verie middest of the Horizon and keeping al things thus at a stay, you may see how euery region or countrie is situated, and how it beareth from you, and which be vnder your Climate and which be not, and to be sure that the Brazen Zenith may stand in his right place, it shall bee needfull to set it so as the left square side therof made with a long notch may touch the selfe same degree of Latitude in the Brazen Meridian, which it hath of altitude, for looke how many degrees the Pole is eleuated aboue the Horizon, which is called the altitude, so many degrees must the brazen Zenith be distant from the Equinoctiall of the Globe, which is called the latitude, and is euer all one with the altitude of the Pole. Thus hauing shewed you how to place the Globe according to the foure quarters of the world, I thinke good now to declare vnto you, first the vses of the terrestriall globe, whereof some are common also to the celestiall globe, as you shall perceiue hereafter by the propositions following, which propositions may be very well deuided into 3. sorts, whereof the

first

first doe properly belong to the description of the vniuersall Map, wherewith the terrestriall Globe is couered, which are but few in number. The second kinde of propositions doe chiefely belong to the Sunne, and to his apparances, which are also common to the celestiall Globe, and may bee found out by either of the Globes. But the third kinde doe belong most properly to the fixed starres and to their apparances, & therefore I mind not to set downe them vntill I come to describe the celestiall Globe, and to shew the vses thereof.

The chiefest propositions belonging to the vniuersall Mappe, wherewith the terrestriall Globe is couered, are these following.

To know vnder what Clime any place or region is, and of how many houres the longest day is there, and also what Latitude any place described in the Map hath.

The 2. Proposition.

HAuing set the Globe at your latitude, bring the place or Region which you seeke right vnder the Brazen Meridian, and the vpper space of the saide Meridian will shewe the Clime. And the second or middle space will shew the houres of the longest day. And the third space the Latitude: As for example, if you woulde knowe vnder what Clime London is, then hauing found London, fixe a long needle in the red spot next to the name of London (for all townes for the most part in the Globe are marked with red spots) that done, turne the Globe with your hand vntill the needle doe touch the brazen Meridian, and by staying the Globe there with your hand, you shall find London to be vnder the 8. Clime, and that the longest day in the yeare is there 16. houres and 20. minutes, and the thirde and nethermost space doth shew the Latitude of the place, which is 51. degrees, 32. Againe, by obseruing this order without changing your Latitude, you shall find Venice to bee vnder the 6. Clime, and their longest day to bee 15. houres and somewhat more, and the

the Latitude of that Cittie to bee 44. degrees, 30. and you shall find Ierusalem to bee vnder the third Clime, and the longest daye there to be 14. houres, and the Latitude thereof to be 31. degrées, 30.

How to knowe what Longitude any place described in the Map hath.

Proposition. 3.

THe Globe standing still at your owne Latitude, pricke the nédle in the place whereof you séeke the Longitude, and bring it as before, to the brazen Meridian, and staying it there, looke at what number of degrées the brazen Meridian cutteth the Equinoctiall, & that is the Longitude of the place, counting the degrées from the first degré of the Equinoctiall, which beginneth at the first point of Aries vnto the place of the section: by doing thus, you shall finde the Longitude of London to be 19. degrées, and the Longitude of Venice to be 36. degrées, and the Longitude of Ierusalem to be 67. degrées and 30. minutes.

How to know the distance betwixt any two places described in the Map.

Proposition. 4.

OPen your Compasses so wide as you may set the one foote thereof iust in the one place, and the other foote in the other place, and apply that wideneſse to the Equinoctiall line, counting how many degrées of the Equinoctiall are contained betwixt the two fóet of your Compasses, and by allowing to euery degré 60. miles, you shall haue the

true

true distance of the places. Thus you shall finde the distance betwixt London and Venice to bee 13. degrées, 30. which being multiplyed by 60. maketh 810. miles, and the distance betwixt London and Ierusalem to be 40. degrees. 30. which being multiplyed by 60. maketh 2430. miles. And it maketh no matter to what part soeuer of the Equinoctiall you doe apply the widenes of your Compasses, so as you set the first foote at the very beginning of some one degree, and let the other foote fall out as it will, either at a whole degrée, at a halfe, or at a quarter of a degree, which small parts are to be counted by minutes by coniectural discretion. And note here that no two places can be distant one from another East and West more then 180. degrees which is iust the one halfe the circuit of the Earth, beyond which halfe or on this side thereof the places must needes be neerer together by meanes of the roundnes of the Earth, and if either of the two places whereof you would know the distance be not expressed in the Globe, then learne to find out the Longitude and Latitude thereof by some Table, whereof the first Meridian is supposed to passe through the Ilands of Canariæ, and marke vpon the Globe where the saide Longitude and Latitude doe crosse, for there ought that place to stand which is missing, to which place direct the one foote of your Compasses and then worke as before is taught. And by this meanes you may also knowe the distance betwixt any two starres contained in the Globe.

To know how one place beareth from another.

Proposition. 5.



Though you may partly finde out this by marking the direction of the lines, proceeding from the Mariners Compasse set downe in the Globe: yet in mine opinion it is readier to doe it by applying the Flie described in my little treatise of vniuersall Mappes, vnto the Globe by setting the center thereof vppon the first place from whence you goe, and by drawing

drawing a thread through that place whereto you would goe, in such order as is there taught, so you shall find Venice to beare from London South East and by East, and Ieruſalem to beare from London East, South East, and two quarters more towards the South. But Gemma Friſius teacheth to know by the Globe how one place beareth from another thus, hauing ſet the Globe and alſo the Zenith of the quarter of altitude at ſuch Latitude as the firſt place or region hath, from whence you would goe, bring that firſt place vnder the brazen Meridian, & there ſtay the Globe vntil you haue brought the quarter of altitude to the ſecond place and the neither end of the quarter of altitude will ſhew you vppon the Horizon amongſt the winds, how the ſecond place beareth from the firſt, ſo ſhall you finde Hiſpaniola to beare from Spaine right Weſt, theſe be the chiefeſt propoſitions belonging to the vniuerſal Map, wherewith the terreſtriall Globe is couered, and therefore I will now ſet downe thoſe that belong to the Sunne, which may be done as well by the one Globe as by the other, and firſt how to find out the place of the Sunne.

How to finde out by the Globe the place of the Sunne, that is to ſay, the degree and minute of that ſigne wherein the Sun is euery day throughout the yeare.

Propoſition. 6.

THough the ſureſt way bee to finde it out by the Ephemerides, which ſheweth the very minute, yet without hauing reſpect to the minutes, you may find it out by the Globe thus, ſeeke out the day of the moneth vpon the Horizon, and that will point you to the degree of the ſigne wherein the Sunne is that day: As for example, the 6. day of May pointeth right to the 25. degree of Taurus the Globe ſtanding leuel, and your rule being rightly laide vpon the Horizon, but during the leape yeare you muſt adde one degree more than the Horizon ſheweth euery day from the beginning of the leape yeare throughout all that yeare.

How

How to rectifie the Index of the houre wheele for euery ſeuerall day throughout the yeare.

Propoſition. 7.

HAuing placed the Globe at your Latitude and alſo found out the degrée of the Sunne as is before taught, bring that degrée of the Sunne to the Brazen Meridian, & ther ſtaying it with the one hande, turne with your other hande the Inder of the houre wheéle to the higheſt part of the ſaid wheéle, marked with the number of 12. ſetting the point of the Inder iuſt with the ſtreéke of the wheéle made to ſhew the houre of 12. of nonetide, and that will ſerue your turne for all that day, and thus muſt you doe euery day in which you haue to vſe the helpe of the ſaid houre wheéle for any purpoſe

How to know euery day at what houre the Sunne riſeth or ſetteth.

Propoſition. 8.

HAuing ſet the Globe at your Latitude, & rectified the Inder of the houre wheéle by the 7. propoſition, turne the Globe to the Eaſt, ſo as the degrée of the Sunne may touch the Horizon, and then the inder of the houre wheéle will ſhewe you at what houre the Sunne riſeth, Againe, if you bring the ſaide degree of the Sunne vnto the Weſt part of the Horizon, the Inder of the houre wheele will ſhew you at what houre hee goeth downe. As for example, Anno 1590. the third of June, the Sun being in the 21. degree 3′3 of Gemini. I bring the point to the very edge of the Horizon on the Eaſt part thereof, and there ſtaying

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ting it, the Index of the houre whéle sheweth that the Sunne ryseth 8′. before foure of the clocke in the morning: and the sayde point of the Ecliptique being turned to the West parte of the Horizon, the Index sheweth that hee setteth 8′. after 8. of the clocke at night.

How to know in what part of the Horizon the Sunne riseth and setteth euerie day,

Proposition. 9.

SEeke the degrée of the Sun in the Ecliptique line, and turne it to the East parte of the Horizon, then you shall sée whether it ryseth iust East or not, and whether it inclineth towards the South, or towards the North, and likewise by bringing the saide degrée to the West part of the Horizon, you shall sée in what part of the said Horizon he goeth downe: As for example, in the last proposition the Sunne being in the 21. degrée, 3′3. of Gemini, and brought to the East part of the Horizon, I find that the Sun did rise distant from the East towardes the North 38. degrées, 3′0. of the Horizon, which is three points and somewhat more of the Marriners Compasse from East, towardes the North, so as the Sunne riseth Northeast and by East, and a little more Northward, and the said place of the Sunne being brought to the West part of the Horizon, I find that he setteth North West & by West and somewhat more Northward.

How

How to know the length of euery day and night throughout the yeare, as well by helpe of the houre wheele as by counting the degrees vpon the Horizon.

Proposition. 10.

FIrst you must know when the Sun riseth and setteth by the eight proposition, then loke how many houres the Inder doth go from the Sunne rising to the Sun setting, and that is the length of ỳ day, which number if you take from 24. the night will appeare: as for example, knowing by the 8. proposition, that the Sunne being in the 21. degrée, 3′3. of Gemini, riseth 8′. before 4. in the morning, and goeth downe 8′. after 8. of the clocke at night, I find by counting the houres which the Inder of the houre wheele hath run, that the length of the day is 16. houres and 1′6. which you may know also by counting the degrées vpon the Horizon from the place of the Sunnes rising, vnto the South point of the said Horizon, which you shall find to be 128. degrées, which being doubled maketh 256 degrées, which if you diuide by 15. it will make 16. houres and 1′6. as before.

How to know by the Globe how much the Sunne declineth euery day throughout the yeare from the Equinoctiall.

Proposition. 11.

HAuing found the place of the Sunne, bring the same to the Brazen Meridian, and by counting how many degrées are betwixt that place and the Equinoctiall, you shall know what declination the Sun hath that day: As for example, supposing the Sun that day you seeke to bee in the first degree of Gemini, bring the said degree of the Ecliptique

cliptique to the brazen Meridian, and you shall find vpon the same Meridian the Sunne to be declined from the Equinoctiall Northward almost 20. degrées. Againe, supposing the Sunne to bee in the first degrée of Aquarius, if you bring the said degrée of the Ecliptique vnto the Meridian, you shall finde the declination of the Sunne to be almost 20. degrées Southward.

How to knowe by the Globe the Meridian altitude of the Sun, that is to say, his height at noonetyde euery day throughout the yeare, and how far he is then distant from your Zenith

Proposition. 12.

BRing the place of the Sunne that day you seéke to the brazen Meridian, and staying it there, count vpon the said brazen Meridian, how many degrées are contained betwixt the place of the Sun and the South point of the Horizon, and that is the Meridian altitude of the Sunne for that daye, which if you subtract from 90. the remainder will shew how many degrées hee is distant that day at noonetide from your Zenith: as for example, supposing the Sun to be that day you seéke in the first degrée of Taurus, bring that degrée of the Ecliptique to the brazen Meridian, and stay it there vntill you haue counted how many degrées of the said Meridian are contained betwixt the place of the Sunne, and the South point of the Horizon, and you shall finde the number of degrées to be 50. which is the Meridian altitude of the Sunne for that day, which 50. degrées being taken out of 90. there remaineth 40. and so many degrées the Sunne is that day at noonetide distant from your Zenith. The like order is to be obserued in seéking to know the Meridian altitude of any Starre, or any other point in heauen.

How to know the altitude of the Sunne at any other houre of the day.

Propoſition. 13.

HAuing rectified the Inder of the houre-whéle by the ſeuenth propoſition, if the houre which you ſéke bee in the forenoone, turne the Globe ſo as the inder of the houre whéle may touch that houre of the forenoone, at which you deſire to know the altitude of the Sun, and ther ſtay the Globe, vntill you haue brought the quarter of altitude on the Eaſt ſide of the Globe vnto the place of the Sunne, ſo ſhal you find vppon the ſaid quarter the altitude of the Sunne at that houre. And if you deſire to know the altitude of the Sunne at any houre in the afternoone, then turn the Globe ſo as the Inder of the houre whéle may touch the houre of the afternoone, and there ſtay the Globe vntill you haue brought the quarter of altitude on the Weſt ſide of the Globe vnto the place of the Sunne, and the ſaid quarter will ſhew you the altitude of the Sunne at that houre. As for example, I would knowe how high the Sunne is at 8. of the clocke in the morning, the Sunne being in the firſt degré of Taurus: there hauing rectified the Inder of the houre whéle, I turne the Globe ſo as the inder of the houre whéle may lie vppon the 8. houre of the forenoone, and there I ſtay the Globe vntill I haue brought the quarter of altitude on the Eaſt ſide of the Globe vnto the place of the Sunne, whereby I find the altitude of the Sunne at that houre to be almoſt 28. degrées. Againe, if you will know how high the Sunne is being in the ſame degré of the Ecliptique at 5. of the clocke in the afternoone, then turne the Inder of the houre whéle, ſo as it may touch that houre, and ſtay it there vntill you haue brought the quarter of altitude on the Weſt ſide of the Globe vnto the place of the Sunne, ſo ſhal you find the altitude of the Sunne to be at that houre 21. degrées.

How

How to know the houre of the day by the Globe.

Propoſition. 14.

THis is to be done two manner of wayes, the firſt is thus, ſet the Globe in ſome open place whileſt the Sunne ſhineth, and you muſt ſée that it ſtand both leuell and alſo right North and South, as is taught in the firſt Propoſition, and that the Inder of the houre whéele bee rectified according to the degrée of the ſigne wherein the Sun is that day by the ſeuenth Propoſition, that done, fixe a néedle in the place of the Sunne, and turne the bodie of the Globe to and fro vntill the néedle caſt no ſhaddow at all, and there ſtaying the Globe, the Inder of the houre whéele will ſhewe you the houre of the day. But if you ſéeke the houre in the forenoone, remember to turne the Eaſt ſide of the Globe towardes the Sunne, if in the afternoone, then turne the Weſt ſide of the Globe towardes the Sunne. The ſecond way is thus, hauing rectified the Inder of the houre whéele, take the altitude of the Sunne with ſome Quadrant or Aſtrolabe, and hauing marked the ſame altitude vppon the quarter of altitude, applye it to the degrée of the Sunne on the Eaſt ſide of the Globe if it be in the forenoone: but if it be in the afternoone applie the quarter of altitude to the degrée of the Sunne on the Weſt ſide of the Globe, and the Inder of the houre whéele will ſhew you the houre which you ſéeke. As for example, the 6. of June 1590. the Sunne being in the 24. degrée, 24. of Gemini, I found by my Aſtrolabe the altitude of the Sunne to be 48. degrées, which I marked vppon the quarter of altitude, and becauſe I tooke the altitude of the Sunne in the forenoone, I brought the quarter of altitude marked with that degrée to the place of the Sunne on the Eaſt ſide of the Globe, and there ſtaying the Globe I founde that the Inder of the houre whéele did point to the ninth houre of the forenoone and ſomewhat paſt. The like is to bee done to know any houre of the afternoone, ſo as you forget not to apply the quarter of altitude vnto the place of the Sunne on the Weſt ſide of the Globe.

And by taking the altitude of any knowne Starre, and working in like manner as before, you shall knowe the houre of the night, as shall bee taught hereafter when wee come to treate of the Starres.

To knowe how much the vnequall houres otherwise called the planetarie houres doe differ from the Artificiall houres throughout the yeare, and how many minutes euery vnequall houre containeth.

Proposition. 15.

FIrst you must know by the 10. Proposition the length of the day, that is to say, how many houres it is long, and reduce those houres into minutes, and diuide the product by 12. and the quotient, together with the remainder (if there be any left after the diuision) will shew you the quantitie of the vnequall houre of the day, that is to say, howe many minutes it contayneth. The like is to be done to know the vnequall houre of the night, for hauing the length of the artificiall night, worke as before, and you shall haue your desire: As for example, knowing by the 10. proposition the length of the day when the Sunne is in the 21. degree, 3′3. of Gemini to bee 16. houres 1′6. here by reducing those houres into minutes, and by deuiding the product thereof by 12. you shall find the vnequall houre of the day to containe 81. minutes and $\frac{1}{2}$. of a minute or 20. seconds, which is more than one whole artificiall heure of the day by 21. minutes and 20. seconds. Againe, knowing the length of the artificiall night by the said proposition to be 7. houres, 44 minutes, if you do reduce the same into minutes, and diuide by 12. you shall find thereby the vnequall houre of the night to containe no more but 38. minutes, and 40. seconds, which is lesse then the artificiall houre of the day by 21. minutes, and 40. seconds.

How

How to know euery day when the dawning of the day and the twilight of the night beginneth and endeth, and the time of their continuance.

Proposition. 16.



Auing rectified the Inder of the houre-wheele by the seuenth Proposition, first find out the opposite point to the degree of the Sunne, and turne the Globe together with that opposite point, and also together with the quarter of altitude towards the West, so as the opposite point may meete euen with the 18. degree of the quarter of altitude, & staying the globe there, the Inder of the houre wheele will shew at what houre the dawning beginneth. As for example, I would know at what houre the dawning of the day beginneth the 19. of Aprill 1590. when as the Sunne is in the 8. degree of Taurus, the opposite poynte whereof is the 8. degree of Scorpio, wherefore I turne the Globe together with the saide point opposite and also together with the quarter of altitude towardes the West, so as the said point opposite may meete euen with the 18. degree of the quarter of altitude, and there staying the Globe, I finde by the Inder of the houre-wheele, that the dawning of the day beginneth at two of the clocke in the morning and 20. minutes after, which dawning alwayes endeth when the Sunne ryseth, as in the former example, the Sun being in the 8. degree of Taurus doth rise 45. minutes after 4. of the clocke in the morning, so as the continuance of the dawning is two houres and 25 minutes, for by taking two houres and 20. minutes out of 4. houres and 45. minutes, there remaineth two houres and 25. minutes. Againe the twilight beginneth when the Sunne goeth downe, which in the former example is at 7. of the clocke and 15. Now to know when the twilight endeth, you must doe thus, turne the Globe and the quarter of altitude towards the East, so as the opposite point, which is the 8. degree of Scorpio

may meete euen with the 18. degree of the said quarter, and the Index of the hourewheele will shew you the twilight endeth at 9. of the clocke and 4′5. after, so as the continuance of the twilight is two houres, and 3′0. for by taking seuen houres and 1′5. out of 9 houres and 4′5. there remaineth two houres and 3′0. But you haue to vnderstand, that the dawning and twilight is not alwaies to be knowne throughout the yeare by the Globe, for from the 11. day of May to the 10. of July, you shall finde that the opposite point of the Sunne will not agree iust with the 18. degree of the quarter of altitude: because that no opposite point during that time will amount to aboue 16. or 17. degrees of the quarter of altitude at the most, because the Meridian altitude it selfe of anye such opposite point is not aboue 17. degrees, for during all that time both dawning and twilight had neede in this our Latitude to be accounted as night, vnlesse you will make no night at all.

How to knowe the ascention of the Sunne both right and oblique.

Proposition. 17.

HAuing set the Globe at your Latitude, bring the degree of the Sunne to the Brazen Meridian, and there staying it, marke at what number of degrees the said Meridian cutteth the Equinoctiall, counting that number from the first point of the vernall Equinoctiall point to that section, and that is the right ascention. As for example the Sunne being in the first degree of Gemini and brought to the Meridian, you shall find that the Meridian cutteth the Equinoctiall in the 58. degree thereof, and that is his right ascention. Now if you would know his oblique ascention, being in the first degree of Gemini, bring that degree to the East part of the Horizon, so as it may touch the vpper edge thereof, and staying the Globe there, looke what degree of the Equinoctiall toucheth the Horizon at that instant, which you shall find

to

to be the 30. degrée of the Equinoctiall, and that is his oblique ascention. These are the chiefest proposítions that belong to the Sunne, and are to be found by either of the Globes, wherefore I will now procéede to those propositions that are to be known most properly by the celestiall Globe, But first I will make a description of the said celestiall Globe, whereby it shall plainely appeare wherein the one Globe is like the other, and wherein the one differeth from the other.

The 18. Proposition, containing the description of the celestiall Globe, and shewing wherein it is like or differing from the terrestriall Globe.

Proposition. 18.

THe Celestiall Globe is like to the terrestriall Globe, in that it is round, hauing both like Axletrées, Poles, hourewhéele with his Inder, brazen Meridian, quarter of altitude of brasse or Latton with his square head or Zenith, and a halfe circle of brasse or Latton called the semicircle of position, also a standing foote with an Horizon of wood diuided into 7. seuerall spaces, containing in a maner the selfe same things that are before described in the Horizon of the terrestriall Globe, also in the body of the celestiall Globe are set downe certaine Circles like vnto the terrestriall Globe, that is to say, the Equinoctiall and the Ecliptique line. Moreouer the foure lesser Circles, that is to say, the two tropiques, the Circle Arctique, and the circle antarctique. But the celestiall Globe differeth from the terrestriall Globe in these foure things following. First the celestiall Globe hath one thinne demicircle of brasse or Latton more than the terrestriall Globe hath, which Demicircle is diuided into two quarters, each quarter containeth 90. degrées, made so at ech ende as it may bee fastened when néede is, vppon the two Poles of the Zodiaque, to find thereby the Longitude and Latitude of euery Starre described in the Globe, and therfore may be-

ry well be called the Semicircle of Longitude and Latitude. The second difference is, that whereas the terrestriall Globe is traced with 12. Meridians, diuiding the Equinoctiall into 24. spaces, euery space containing 15. degrees. The celestiall Globe is onely traced with 6. Meridians, diuiding the Equinoctiall into 12. spaces, euery space containing 30. degrees. The thirde difference is that the celestiall Globe hath not those 8. Parallels of Latitude wherewith the terrestriall Globe is traced. The fourth difference is that whereas the terrestriall Globe is couered with an vniuersall Map containing the foure principall diuisions of the earth, that is, Europa, Africa, Asia and America: the celestiall Globe is couered with a Map, wherein are painted all the fixed Starres that were knowne to the auncient Astronomers deuided into 48. Images, with which Images, to the intent you might be the better acquainted, and that you might the more readily finde out any Starre described in the Globe, I thought good to set downe a particular description of the said 48. Images as followeth.

The 19. Proposition, contayneth a particular description of the 48. Images of the fixed Starres that are in the celestiall Globe together with their sundrie names and also the names of so manie Starres as are named in the Globe, of which 48. Images 21. are ascribed to the North parte of the firmament, 12. to the Zodiaque, and 15. to the South part of the firmament.

Proposition. 19.

THis description is deuided into two partes according to the twofolde declination of the fixed Starres, that is to say, Northern & Southern, for those Starres are saide to haue North Declination, which are situated betwixt the Equinoctiall, and the North pole, and those to haue South declination which are situated betwixt the Equinoctiall, and the South pole, and because that sixe great Circles or Meridians, passing through the Poles of the world, do deuide

deuide the Equinoctiall into twelue equal spaces, euery space containing 30. degrées, I will begin my description at the first point of Aries, which is the Vernall Equinoctiall point, and so proceéd towardes the right hand round about the Globe, setting downe all such Images, or parts of Images as are situated towardes the Northe pole, and are contained in euery seuerall space betwixt two Meridians, and hauing described all the Northe part, I will vse like order in describing the South part. And you may beholde all the Northern Images by turning the Globe about with your hand without taking the same out of his bed or seate, the pole being eleuated aboue the Horizon. 50. or 60. degrées, but to viewe the Southern Images, it shal be néedfull to take the Globe cleane out of his seate, and to hold it so as the Northe pole may stand right vp, so shall you sée euery Southerne Image and Starre at your pleasure. And yet to know how the Starrs are situated in heauen, you haue néede to imagine your selfe to be within the Globe, in the very center thereof and not without the Globe for otherwise those starres that are situated in heauen on your right hand, if you haue regarde to the outside of the Globe, will seeme to be on your left hand.

The Northern Images contained in the first space intercepted betwixt the first Meridian and the second Meridian.

IN this space you shall first see next vnto the Equinoctiall the following Fish of the signe Pisces together with the bond, both Southerne and Northerne, called in Latine Linum australe & Septentrionale, also the knot of the bonde, which is called Nodus, Syndesmon, and hipouraion, which is a faire star of the third bignes.

Item the first part of Aries with the two Starres in his right horne from the former Starre, whereof the Astronomers doe alwaies make their computation.

Item the whole Image of Andromeda, her heade and right arme excepted, in whose girdle is a Starre of the third bignes called Mirach, and in her left foote a Starre of the third bignes called Alamac.

Item

Item the Triangle called Triangulus and Deltoton with his foure starres.

Item the whole Image of Casiopeia sauing her right arme, and the vpper part of the backe of her chaire, in whose breast is a starre of the third bignes called Shedar.

The Northerne Images contained in the second space.

FIrst the head of the Whale called Cetus in whose snout is a starre of the third bignesse called Menkar.

Item all the hinder parts of Aries called in Greeke Chrios, in English the Ram.

Item the right legge, necke, breast, right eare, and mozell of the Bull, in whose right thigh towards the shoulder point is a starre of the fourth bignesse called Alfon and in his breast a starre of the third bignesse called Alfo, and in his Mozell lying vpon his right legge, is another starre of the third bignesse called Alfon, and in his necke toward the Withers are 7. starres of diuers bignes called by these diuers names, that is, Vigilie, Atlantides, Pleiades and Athoratæ, commonly called the seuen Starres.

Item the whole head of Medusa, called Caput Medusæ vel Gorgonis, and Ras Algol.

Item the whole image of Perseus otherwise called Chelube, his right hand, swozd, and right foote excepted.

The Northerne Images contained in the third space.

FIrst the left leg of the Bull hauing 2. starres thereon: mozeouer his head, hozne and most part of his right eare, on whose left eye is a starre of the first bignesse, called Oculus Tauri, Palilicium, and Aldebaran, also in his face are certaine lesser starres called succulæ and Hyades.

Item the vpper part of Orion otherwise called Alguze, holding a club in his right hande, and a Lyons skin in his left hand on whose right shoulder is a Starre of the first bignesse called Bed Alguze, & on his left shoulder a star of the second bignesse called Bellatrix.

Item

Item the left foote of the former Gemini, containing two starrs of the fourth bignesse, whereof the one is called Propous.

Item the whole Image of Auriga, otherwise called Erichthonius and Heniochos, holding a reane and a whip in his right hand and hauing a Goate hanging on his backe, which hath two little Goates sucking her behinde, which be two starres of the seconde bignesse, called by diuers names, as Hedi, Heriphoi, and Sadateni, and in the flanke of the Goate is a starre of the first bignesse called hircus, aix, holenic and Alhaiot.

The Northerne Images contained in the fourth space.

FIrst the whole Image of the little Dog, in whose left flanke is a starre of the first bignes called Canis minor, Procion, Algomeisa, and Alsahere.

Item the whole Image of the two twinnes called Gemini or Didimoi, the left foote of the former twin only excepted, which former twin is called Apollo, Castor, Anhelar, and the other is called Pollux, and Abrachaleus, in whose left eare is a star of the seconde bignes called Ras Alguze.

Item the tayle and halfe body of Cancer.

Item the Nozell of the great Beare, whereon is a Starre of the fourth bignesse.

The Northerne Images contained in the fifth space.

FIrst the head and necke of Hydrus.

Item the foze part of Cancer, called in Greeke Carchinos, vpon whose right Clea is a starre of the fourth bignes called Acubene, and betwixt his head and his right Clea is a starre called Presepe, Phatue, and Meelleph, and on his backe are two starrs called Aselli and Onoi.

Item the foze part of Leo against whose hart is a Star of the first bignesse, called with these names, Cor Leonis, Regulus, Basileus, and Calbalezet.

Item the foze part of the great Beare called Vrsa maior, Arctos Eliche, and Calisto.

The

The Northerne Images contained in the sixt space.

FIrst the hinder parts of Leo otherwise called Alezet, in whose taile is a starre of the first bignesse called Cauda Leonis, and Deneb Alezet.

Item the head and shoulders of Virgo.

Item the darke starre of Bernices haire.

Item the hinder parts of the great Beare, his tayle excepted.

Item the hinder parts of the Dragons taile, containing two starres of the fourth bignes.

The Northerne Images contained in the seuenth space.

FIrst, the most part of Virgo, who is otherwise called Parthenos, Erigone, Preuindemiator, Protigiter, Almucedie, and Alaraph.

Item the left leg and left arme of Bubulcus, otherwise called Bootes, Vociferator, Arctophilax and Lanceator, betwixt whose legges is a starre of the first bignes called Arcturus, Asimech, and Alramech.

Item Bernices haire, called Cincinnus, Cesaries, plochamos, Berenices crinis, and Trica.

Item the tayle of the great Beare containing three starres of the third bignes, wherein that next his rumpe is called Aliot, and that which is in the tippe of his tayle, is called Benenacz.

Item a part of the Dragons tayle containing two stars standing nigh together nigh vnto the Circle Arctique.

The Northerne Images contained in the eight space.

FIrst the head and necke of the serpent called Anguis Serpens, Engchelis and Ophis.

Item the crowne of Ariadna, called Corona gnosia, Stephanos Ariadnis, and is commonly called Corona Septentrionalis that is, the Northern Crowne, in which is a Starre of the second bignes called Malfelcare, Alpheta and Muniir.

Item

Item the most part of the Image of Bubulcus, hauing a club in his right hand, in whose left shoulder is a Starre of the fourth bignesse called Ceginus, and there is another of the fourth bignesse in his club, right against his face called Incalurus.

Item the fore part of the little Beare called Vrsa minor, arctos and Cinosura.

The Northern Images contained in the ninth space.

FIrst the vpper part of Serpentarius, otherwise called Ophiucos, and alangue in the Crowne of whose head is a star of the third bignesse called iras a langue.

Item the whole Image of Hercules with the Lyons skin hanging on his left arme, otherwise called Engonasi, algethi, Nessus, and ignotum idolum (his right hand holding the club, & his right leg excepted) in whose head is a starre of the third bignesse, called Ras Algethi, and this Image lyeth groueling with his heels towards the North pole, and his head towardes the Equinoctiall, which meeteth almost with the head of Serpentarius.

Item the head of the Dragon called Draco & Aben, in whose head is a Starre of the third bignes called Ras Aben.

Item a part of his tayle containing 6. starres.

Item the hinder part of the little Beare, containing two stars.

The Northern Images contained in the tenth space.

FIrst, the vpper part of Antinous, hauing at each elboe a star of the third bignesse.

Item the last end of the Serpents tayle, in the tip whereof is a starre of the fourth bignes.

Item the whole Image of the Eagle called Aquila, Vultur volans, Aetos and Alcair.

Item the whole Image of the Shaft called Sagitta, Telum, and Hoistos.

Item the whole Image of the Harpe called Lira and Alohore, that is to say, Vultur cadens, and Chelis, in the vpper part whereof towards the left hand is a faire starre of the second bignesse called

led Fidicula, lira, Alangue, vega, and Brineck.

Item the head, necke, and left wing of the Swan, called Auis, Cignus, Olor, Hornis, Adigege, and of some Gallina.

Item the necke, body and fore part of the Dragon contayning 11. Starres.

Item part of the little Beares taile, contayning one Starre next to his rumpe of the fourth bignes.

The Northerne Images contained in the 11. space.

FIrst, the Crowne of Aquarius his head, contayning one Star of the fift bignes.

Item the little horse called Equus and Hippos, whose necke is inclosed with a cloud, and in his head are foure little starres.

Item the head and two fore fæt of the winged horse called Pegasus, on whose right nostrell is a Starre of the third bignes called Eniph Alpharaz.

Item the Dolphin called Delphinus, containing ten Starres, whereof one is of the third bignes.

Item the body, legs, and the right wing of the Swan, which lyeth on her backe with her bellie vpward, in whose body towards the taile, is a faire Starre of the seconde bignes called Deneb Adigege, and Arided.

Item the right arme and right leg of Cepheus, on whose right shoulder is a star called Alderaimim.

Item part of the little Beares tayle contayning the middle starre of his tayle.

The Northern images contayned in the 12. space.

FIrst, the most part of the former fish of the signe Piscis together with part of her band.

Item the necke, bodie, and wing of Pegasus, otherwise called Equus Gorgoneus, and Alpharaz, rising out of a cloud, in which cloud is the head of Andromeda, hauing on the right side thereof a faire starre of the second bignes, and in the right wing of Pegasus is a starre of the second bignes called Marcab Alpharaz,

and

and on his right shoulder another Starre of the seconde bignes called Scheat Alpharaz.

Item the right arme and hand of Andromeda holding part of her chaine, in the ring whereof is a Star of the fourth bignes.

Item the right arme of Cepheus.

Item the tip of the little Beares taile, in which is the North Star called Alrucuba of the third bignesse.

The names of the images contayned in the celestiall globe betwixt the Equinoctiall and the South Pole together with so many starres as are named in that part of the globe, beginning as I did before in describing the northern Images at the Vernall Equinoctiall point, and so proceede from space to space contained betwixt euery two Meridians towardes the right hand.

The Southern Images contained in the first space, beginning at the Vernall Equinoctiall point.

FIrst the most part of the Whale called Cetus, Pistrix, and Balena (his head and fore part of his belly excepted) in the mid body whereof towardes the backe, is a starre of the fourth bignes called Baten Kaetos, and in the lower part of his taile is another starre of the third bignes, called Deneb Kaitos.

The Southern Images contained in the second space.

THe fore part of the Whalles bellie and his ghilles, contayning fiue Starres.

Item the most part of the floud Eridanus, called of some Nilus, and in Greeke Potamos Eridanos, contayning 22. starrs, whereof one is called Angetenar, which is about the middest of the Floud nigh vnto the Whales bellie, and there is in the very end of the Floud another starre of the first bignesse, called Acarnar.

The Southern Images contayned in the third space.

First

FIrſt, the ſnether part of Orion or Alguze from the middle of his backe downeward, in whoſe girdle are three faire ſtarres, whereof the middle ſtarre is of the ſecond bigneſſe called Orion or Alguze.

Item another part of the ſtreame Eridanus which ſeemeth to come from the left foote of Orion, which ſtarre in his left foote is called Algebar, Rigel, Alguze.

Item the whole Image of the Hare, called Lepus and Lagos containing 12. little ſtarres.

Item the reſt of Eridanus containing foure Starres, whereof there is one called Beemum of the fift bigneſſe.

The Southerne Images contained in the fourth ſpace.

FIrſt, the whole Image of the great Dog called Canis maior, and Syrios in whoſe mouth is a ſtarre of the firſt bignes called Aſceher and Alhabor.

Item the fore part of the great ſhip Argos, with her two Dares hauing a ſcutcheon with 4. Starres, the greateſt whereof being of the third bignes is called Markeb, and vnder the vpper hatches in the fore part of the ſhip is a Starre of the fift bigneſſe called Alphard, and in the left Dare towards the South pole, is a faire ſtar of the firſt bigneſſe, called Canopus and Suhel.

The Southerne Images contained in the fift ſpace.

FIrſt, the mid part of the Serpent called Hydrus and Aſuia, in the which is a faire ſtar of ꝑ ſecond bignes called Alphard.

Item the hinder part, maſt and toppe of the ſhip Argos, which ſeemeth to come out of a cloud, containing diuers Starres of diuers bignes without name.

The Southerne Images contained in the ſixt ſpace.

ITem another part of Hydrus whereupon ſtandeth the Image of the cuppe or boule called Crater, vas and patera, and alſo the Crowes head.

Item

Item the hinder part of Centaurus, in euerie part whereof are diuers Starres without name.

The Southerne Images contained in the seuenth space.

FIrst the left wing of the signe Virgo and her left hand holding an eare of wheat, whereon is a Starre of the first bignes, called Spica Virginis, Hachis, Acimon, Alacel, and Azimech.

Item the Crowe called Coruus and Corax, his head and necke excepted, in whose left wing is a starre of the fourth bignesse called Algorab.

Item the rest of Hydrus, whereon the Crow standeth, contayning three starres without name.

Item the rest of Centaurus or Chiron with his boyestaffe trimmed with boughs, his right hand and right foote excepted.

The Southerne Images contained in the eight space.

THe whole Image of Libra, the ring onely excepted.

Item the fore part of Scorpio, whose fore cleas do lie vpon the two ballances, that is to say, his right clea vpon the North ballance, and his left clea vpon the South ballance, hauing vpon ech clea a starre of the second bignes.

Item part of the Serpent called Anguis or Ophis, hauing one Starre of the fourth bignes.

Item the left hand of Serpentarius, holding part of the Serpent, vpon which hand are two Starres of the third bignes called Yedd.

Item vpon the head of Scorpio are 3. starrs of the third bignes, standing all in a row and diuers others as well vpon his backe as vpon his left little clea without name.

Item the whole Wolfe called Fera, Lupus and Therion.

Item the right hand of Centaurus holding the saide Wolfe by the belly in both which are diuers starres without name.

Item the right foote of Centaurus, in which is a faire starre of the first bignes, and is called by the name of Centaurus.

The Southerne Images contained in the ninth ſpace.

FIrſt, the nether part of Serpentarius, that is to ſay, from his mid backe downward, hauing the ſerpent winding betwixt his legs and aboue his right arme, in both which are diuers Starres without name.

Item the hinder part of Scorpio from his mid body to the outtermoſt ende of his tayle, who hath diuers names, as Scorpius Nepa, Alatrab, in the midſt of whoſe body is a faire Starre of the firſt bigneſſe called cor Scorpionis, Antares, and chalb Alatrab, and in the tip of his tayle are two Starres of the third bigneſſe, called Alaſcha and ſcomlec Alatrab.

Item the moſt part of the Bowe with the heade of the ſhaft of Sagittarius and his right foote, in all which parts are diuers ſtars without names.

Item the Altar with the flame and ſmoke called Ara, thuribulum, lar, ſacrarium, thimiaterion.

The Southern Images contained in the tenth ſpace.

THe lower part of Antinous from the breaſt downward knéling vpon an Altar containing foure Starres without name.

Item the forepart of Capricornus his head.

Item the Image of Sagittarius, otherwiſe called Crotus, and toxeuter (his bow, the end of his arrow, and his right foote excepted) hauing diuers Starres without name.

Item the Southerne Crowne, called Corona Auſtralis, and Notios ſtephanos, and of Aratus, it is called Dinotos Cyclos, that is to ſay, the Southerne Circle, which Crowne is placed betwixt the two fore legs of Sagittarius, and in the ſaid Crowne are diuers ſtarres, amongſt which there is one of the ſecond bigneſſe touching the left knée of Sagittarius called Corona Auſtralis, who alſo hath on his left foote another Starre of the ſecond bignes without name.

The Southerne Images contained in the 11. ſpace.

The

The fore part of Aquarius otherwise called Ganimedes and Hydrochos, holding a handkercher in his left hand, wherein are three Starres, and hath diuers Starres in his body without name.

Item the whole Image of Capricornus, otherwise called Pan Aigoceros, and Algedi, the fore part of his head onely excepted, in whose taple is a starre of the fourth bignesse called Deneb Aldegi.

Item the hinder part of the Southerne Fish hauing diuers starres without name.

The Southerne Images contained in the twelfth space.

First Aquarius his right hande holding the water pot called Vrna and Chalpi, out of the which he poureth the water down into the mouth of the Southerne fish, which water is called Aqua and hydor in which are diuers starres without name.

Item the lower bellie part of the former fish of the signe Piscis wherein are two starres without name.

Item both the thighes and legges of Aquarius, vpon the calfe of whose right leg is a Starre of the third bignesse called Scheat Aquarii, and Crus *Aquarii*.

Item the head of the Southern fish called Piscis Meridionalis, and Ichthis notios, in whose mouth is a faire starre of the first bignesse, called Fomahant.

But you haue to vnderstand that besides the 15. Southerne Images before mentioned, ther are lately found out by the Portugales and others that haue sailed into the East and West Indies 4. other Images towards the south Pole, as the crosse or Crosier, the south triangle, Noahs doue or Pigion, & another Image made like a Philosopher called Polophilax, all which are set downe in the celestiall Globe, lately set forth, first at the great charges of M. Sanders, and now at the like charges of M. Molinax of Lambeth of whome I lately bought both the Globes, that is, the terrestriall and celestiall, and I wish that the longitude, latitude and declination of euery starre contained in the said 4. Images were truely set downe, for Plancius maketh some doubt thereof. Not-

withstanding if you bee desirous to know the longitude, latitude, and declination of the said Starres by helpe of the foresaide great Globe, then you must worke as I doe shewe you hereafter in seeking for any Starre contained in Mercator his Globe, so shall you haue your desire.

Moreouer, to most of the Stars described in the Globe are annexed the Characters of some of the 7. Planets, to shew the nature and qualitie of the starres and some starres are also marked with some one letter or other, the more readily to finde out thereby the foresaid Characters, As for example, to Cor Leonis are annexed the Characters of Iupiter and Venus, and vnder the said starre is set the letter m. to shew the Characters which are not alwaies set hard by the starre, but sometime a good distance off, for where the characters are set nigh vnto the starre, there needeth no letter, as in the starre called Spica Virginis, whereunto are annexed the characters of Mars and Venus, without any letter to signifie the same, and where diuers starres be of one selfe qualitie, they are seuerally marked with letters of one selfe same shape, as about the Starre Spica Virginis you shall find diuers little Starres, each one marked with the letter h. signifying their nature to be all one, that is, to participate of Mars and Venus, to whose Characters is also ioyned the letter h. signifying that they bee of that nature and qualitie.

The Characters are these here following set ouer euery Planets head.

♄	♃	♂	☉	♀	☿	☽
Saturne.	Iupiter.	Mars.	Sol.	Venus.	Mercurie.	Luna.

The nature of euery one of the Planets here followeth.

SAturne is colde and drie, Iupiter is temperately hotte and moyst. Mars is extreamely hot and drie. Sol hotte and somewhat drie. Venus is temperately colde and moyst, Mercurie is of changeable nature, and plyant to the nature, bee it good

good or bad of euerie other Planet or fixed Starre whereto it is ioyned. Luna is cold and moist.

Besides the Images and starres both Northern and Southern aboue mentioned, there is also set downe in the Celestiall Globe a certaine impression called in Greeke Galaxia, that is to say, the milke white way, the description whereof here followeth.

A briefe description of the milke white waye, called in Greeke *Galaxia*, and in Latine *Via lactea*.

This way as Garceus writeth, proceedeth from the signe Gemini, and so passeth through the legs and loynes of Erichthonius, & from thence through the right side of Perseus, and then through the whole Image almost of Cassiopeia, and from thence through the left wing of the Swan called Auis, Gallina and Cignus, and from thence through the Image called in Latine Telum, in English a Dart, shaft, or quarrel, and from thence through the flying Eagle called in Latine Vultur volans, and from thence through the greatest part of Sagittarius his bow, and from thence through the Alter called Ara and Thuribulum, and from thence through the legges of Centaurus, and so to the ship called Argos, from whence rysing againe, & passing through part of the great Dog called Canis maior, it returneth againe to Gemini.

Thus hauing described vnto you all the 48 Images, and shewed the names of as many Stars as are named in the Globe, and also the milke white way, I mind now to proceede to the propositions belonging to the fixed Stars described in the Globe, as followeth.

How to finde out in heauen anie vnknowne Starre described in the Globe two manner of wayes, that is, either by the

helpe of some knowne star, or els by knowing the true houre of the night.

Proposition. 20.

THe first and surest way is thus, take with your Quadrant or Astrolabe the altitude of the knowne Starre, marking therewith in what part of the heauen the same is situated East or West, North or South, and then hauing set your Globe right North & South, & at the true latitude of the place wher you are, bring the quarter of altitude to the saide Starre, and therewith turne the Globe vntill you see that the said Star hath the like place and the like altitude in the Globe that it had in heauen, then kéeping the Globe still at that stay, séke in the Globe the starre that you would finde out in the firmament, and marke well in what part of the Globe it is situated, and how it beareth from the knowne Star, either East, West, North or South, and bring the quarter of altitude to that Star, that you may know the altitude thereof by helpe of the saide quarter, which altitude once taken, turne your eyes towards that part of the firmament, & hauing placed the Diopter of your Astrolabe at that altitude, look what Star in that part of the firmament doth answere to such altitude, and that is the Starre which you séke, whose name for the most part is set downe in the Globe. The second way is thus, hauing learned the true houre of the night by some clocke or watch, bring the degrée of the Sun vnto the brazen Meridian, and holding it there, set the Inder of the houre wheele iust at the 12. houre, that done, turne the body of the Globe to or fro vntil the inder of the houre wheele fal iust vpon the houre which you seeke, and keeping the Globe at that stay, seeke out the vnknowne starre in the Globe, and consider how it beareth from you in the Globe either East, West, North or South, then bring the quarter of altitude to the Star, that you may know thereby what altitude it hath in the Globe, which once found, and hauing set the Diopter of your Astrolabe at that altitude, turn your eye towards

that

that part of the firmament whereunto the place of the ſtarre found in the Globe directeth you, and that Star which anſwereth to that altitude is the ſtar which you ſeeke. But this way is not ſo ſure as the other way firſt taught, vnleſſe you know the true houre indeed.

How to know by the Globe the Meridian altitude which is the higheſt altitude of any ſtarre, and alſo how high or lowe he is at any other time.

Propoſition. 21.

HAuing ſet the Globe at your latitude, bring the ſtarre to the brazen Meridian, and ther ſtaying it, number vpon the brazen Meridian the degrees contained betwixt the ſaid ſtarre and the South or North point of the Horizon, according as the ſtarre is ſituated either Northward or Southward, for ſo in the Latitude 52. you ſhall find the Meridian or higheſt altitude of the Starre Arcturus or Bubulcus to be 60. degrees. But if you would know his altitude at any other time, then you muſt rectifie the Inder of the houre wheele by the 7. propoſition, and hauing ſet the Inder at the houre wherein you ſeeke, ſtay the Globe there, vntill you haue brought the quarter of Altitude vnto the ſtarre, and that will ſhew the altitude of the ſtarre at that houre if it be aboue the Horizon.

How to know by the Globe what ſtarres are aboue the Horizon at any time of the day or night.

Propoſition. 22.

OF ſtarres according to diuers Latitudes ſome are alwaies aboue the Horizon, and ſome are alwaies vnder the Horizon, and ſome do both riſe & ſet, if you would know what ſtarres bee aboue the Horizon in the daye time, then hauing rectified the Inder of the houre

whéle by the seuenth proposition, take the altitude of the Sunne with your Astrolabe or quadrant, and therewith consider whether the Sunne bee in the East part, or in the West part of the firmament. Then bring the quarter of altitude on the East or West side of the Globe according as you saw the Sunne at that present to be in the firmament, and make the degrée of altitude, marked in the quarter of altitude to méete euen with the degrée of the Ecliptique line wherein the Sunne is that day, and there staying the Globe, you shall sée all the starres that bee aboue the Horizon at that present, as wel on the East side as on the West side of the Globe, and the Inder will shew you at what houre you toke the foresaid altitude. But if it be in the night season, and that the starres doe appeare, take with your Astrolabe the altitude of some knowne starre, and by doing as is before taught, you shall haue your desire. But you must not forget first of all to rectifie the Inder of the houre wheele by the seuenth proposition.

How to know by the Globe at what time any starre ryseth aboue the Horizon, mounteth to the highest, and setteth, and with what degree of the Ecliptique hee ryseth, mounteth, and setteth: and also in what part of the *Horizon* he riseth and setteth.

Proposition. 23.



HAuing rectified the Inder of the houre-whéle by the seuenth proposition, bring the starre to the East part of the Horizon, so as it may touch the edge therof, and the Inder of the houre whéle will shewe at what hour he riseth, and by loking at that instant to the Ecliptique line you shall sée what degrée of the Ecliptique ariseth thē with him. That done, bring the said Star to the brazen Meridian, & the Inder of the houre whéle will shew at what houre hee is at the highest, and there staying the Globe, marke what degrée of the Ecliptique line doth fall right vnder the brazen

brazen Meridian at that instant, for that degree is said to accompanie him when he is at his highest. Then bring the said starre to the West part of the Horizon, and you shal find by the Inder of the houre wheele at what houre he setteth, & what degree of the Ecliptique doth accompanie him at his setting. As for example, I would know the sixteenth day of June 1590. the Sunne being in the fourth degree of Cancer, when Arcturus otherwise called Bubulcus and Lanceator doth rise, mounteth to the highest, and setteth, here hauing rectified the Inder of the houre wheele by the seuenth Proposition, I bring the saide Starre to the East parte and verie edge of the Horizon, and I finde that he riseth a little before twelue of the clocke at noone, and that the 28. degree and 30. of Virgo, riseth with him, and by looking amongst the windes vpon the Horizon right against the place of his rysing, I find that he riseth Northeast and by East. Secondly by bringing the said star to the brazen Meridian, the Inder of the houre wheele sheweth that hee is at his highest halfe an houre after seuen of the clocke at night, and is then plaine South, and that the 29. of Libra, doeth then accompanie him. Thirdly by bringing the said starre to the West part of the Horizon, the Inder of the houre wheele sheweth that he setteth or goeth downe a quarter of an houre before foure in the morning, and that the fourth degree of Capricornus doth accompanie him at his setting: and by looking there vpon the Horizon, I find amongest the winds that the said star setteth Northwest and by West.

How to know in what part of the firmament, any star is, and how many degrees it is distant frō the Meridian at any houre, and being right vnder the Meridian to know how far it is distant from your Zenith.

Proposition. 24.

HAuing rectified the Inder of the houre-wheele by the seuenth Proposition, turne the Globe vntill the Inder touch the houre wherein you seeke. And staying the Globe there, bring the quarter of Altitude to the Starre bee it on the East or West side of the

Globe

Globe, and the nether end of the said quarter will shew vppon the Horizon among the winds, in what part of the firmament the star is: now if you would know how farre that starre is distant from the Meridian doe thus: looke what degree of the Equator is at that instant vnder the Meridian, and there make a marke, and then turne the Globe vntill you haue brought the said starre vnder the brazen Meridian, and marke what degree of the Equinoctiall the said Meridian cutteth at that instant, that done, count the degrees contained betwixt the two markes vpon the Equinoctiall, for so many degrees is the starre distant at that time from the Meridian either towards the East or West, and by allowing 15. degrees to an houre, and 4′. to a degree, you shall know in what time the said starre hath to approch to the Meridian, or how much he is past the Meridian, and hauing brought the said star right vnder the Meridian, you shall knowe how farre it is distant from your Zenith, by counting the degrees that are contained in the Meridian betwixt the said starre and your Zenith. As for example, the sixth of October 1591. (the Sunne being then in the 22. of Libra) I find the starre Cor Leonis at three of the clocke in the after noone to be West, Northwest, and there staying the Globe, I see that the Meridian cutteth the Equinoctiall at the 246. degree, whereas I make a marke, that done, I bring the Starre Cor Leonis to the said Meridian, at which instant the Meridian cutteth the Equinoctiall in the 146. degree, which being taken out of 246. there remaineth 100. degrees, which is his distance from the Meridian, which being deuided by 15. I finde in the quotient 6. houres and 40. for so much as hee is past the Meridian towardes the West, and by bringing the foresaide Starre to the Meridian, I finde him to bee distant from our Zenith 39. degrees, and 30. minutes.

How to find the houre of the night by the Globe.

Proposition. 25.

Hauing

HAuing set the Globe at your Latitude, rectifie the Index at the houre-wheele by the seuenth Proposition, then hauing taken the Altitude of some starre that you know, and is in the Globe with your Astrolabe or Quadrant, bring the quarter of Altitude vnto the starre, be it in the East or West according as you found the star to bee in the firmament, not leauing to turne the Globe vntill you haue made the starre to haue the like Altitude in the Globe vpon the quarter of Altitude, and also the like situation that you found it to haue in the firmament by your Astrolabe or Quadrant, and staying the Globe there, the Index of the houre-wheele will shew the houre: As for example, in the yeare 1590. the first of Januarie the Sunne being in the 22. of Aquarius, I hauing with my Astrolabe found that the starre called Canis maior, that is to say the greater dogge, was eleuated aboue the Horizon in the East part of the firmament. 20. degrees, I brought the quarter of Altitude to the East side of the Globe, not leauing to turne the Globe vntill I had made the star to mete euen with the 20. degree of the quarter of Altitude, and there staying the Globe, I found by the Index of the hourewheele that it was 8. of the clocke at night, and a quarter past.

How to know the verticall starres in euery Latitude.

Proposition. 26

THe Globe and the Brazen Zenith being set according to the Latitude of the place where you are, turne the Globe from East to West, and as many stars as passe right vnder your Zenith are said to bee verticall as in the Latitude 52. you shall see the taile of the great Beare, the head of Perseus & diuers others to passe through your Zenith in turning the Globe from East to West.

How

How to know the true place of any ſtar, that is to ſay, in what ſigne and in what degree thereof any ſtar is.

Propoſition. 27.

HAuing faſtned the ſemi-Circle of Longitude and Latitude vppon the two poles of the Zodiaque, the North pole whereof is in the Circle Arctique not far from the right clawe of the Dragon, and the South pole thereof is in the Circle Antarctique right oppoſite to the other, then bring the ſaid ſemi-Circle to the ſtarre, whoſe place you ſéeke, and marke therewith what point of the Ecliptique the ſaid ſemi-circle cutteth, and that is the place of the ſtarre. As for example, by bringing the ſaid ſemi-Circle to the ſtarre called Hircus, that is to ſay, the Goate, I find it to be in the 15. degrée 30. minutes of Gemini, and that is his place.

How to finde the Longitude of any ſtarre by the Globe.

Propoſition. 28.

IHaue tolde you in my Spheare, that the Longitude of any ſtarre is that arch or portion of the Ecliptique line, which is contained betwixt the firſt point of Aries, and that Circle which paſſeth through the Poles of the Zodiaque, and alſo through the bodye of the ſtarre, which Circle, the ſemi-Circle of Longitude and Latitude here repreſenteth: and by making the ſaid ſemi-Circle to paſſe through the ſtarre called Hircus before mentioned, I finde that the number of degrées of the Ecliptique, contained betwixt the ſaid Circle and the firſt point of Aries to be 75 degrées and 30 which is the Longitude

gitude of the ſaid Starre, and thereby maketh his place to be in the 15. degree 30. of Gemini, as before is ſet downe in the laſt Propoſition.

How to find out the Latitude of any ſtar.

Propoſition. 29.

I Told you alſo in my Spheare, that the Latitude is none other thing, but the diſtance of any ſtarre from the Ecliptique line either towards the North or South pole of the Zodiaque, which diſtance the ſemi-Circle of Longitude and Latitude made to paſſe through the body of the ſtarre, and cutting the Ecliptique line doth alwaies ſhew, as in the former example, in making the foreſaid ſemi-Circle to paſſe through the foreſaid Starre called Ircus, I find by counting the degrees of the ſaid ſemi-circle contained betwixt the Ecliptique line and the body of the ſtarre, that the Latitude of that Starre is 22. degrees and 30. minutes towards the North, likewiſe by bringing the ſaid ſemi-Circle to the ſtarre which is in the right ſhoulder of Orion called Bed Alguze, I find his Latitude to be 17. degrees towards the South.

How to find out by the Globe, the declination of any ſtarre.

Propoſition. 30.

THe declination is none other thing but the diſtance of any ſtar from the Equinoctiall either towards the North pole or South pole of the worlde, which is to bee founde thus: Firſt hauing brought the ſtarre right vnder the brazen Meridian, and there ſtaying the Globe, count the degrées of the ſaid Meridian contained betwixt the ſaid ſtarre

and

and the Equinoctiall point or stræke of the said Meridian, & that shall be the declination of the starre: As for example, bring the star Hircus vnto the Meridian, and you shall find the declination thereof to be 45. degrées towardes the North pole of the world, and that the starre which is in the foote of the Hare called Lepus, hath of South declination 23. degrées.

How to know the magnitude or greatnes of any star, and his nature and qualitie by the Globe, and also the right ascention of the Arque of the Ecliptique, which accompanieth the right ascention of any star.

Proposition. 31.

MArcator describeth the sire magnituds of ỹ Stars by making the sire figures or shapes of starres placed not farre from the head of the great Beare, whereof the first and greatest hath 16. points or beames, the seconde eight, the third sixe, the fourth sine, the fift sixe, which indæde by that account woulde be but foure: and the sixth hath sine, which wold haue but 3. but in mine opinion it had bæne better to haue made the first magnitude with ten points, the second with nine, the third with eight, the fourth with seuen, the fift with sixe, and the sixt with sine: so should the magnitude of euerie starre described in the Globe haue bæne the more easily knowne. But to the intent that you might exercise your selfe in finding out by the Globe, the place, Longitude, Latitude, and declination of any Starre that is described in the Globe: I haue thought good to adde hereunto the Table of Garceus, shewing not onely the Longitude, Latitude and declination of the most notable Starres that are both Northward and Southwarde, but also the right ascention, magnitude or bignesse, the qualitie and nature of euerie such Starre, and also the Arch of the Ecliptique line, which accompanieth the right ascention of euery Starre, which Table though

though by the said Garceus was calculated out of the Astronomicall Tables for the yeare of our Lord 1564. and not by the Globe, yet for your better exercise in matters of the Globe I thought good to set downe such Longitude, Latitude, declination, magnitude, and right ascention, and all other things contayned in the said Table, according as they are to be found out by the Celestiall Globe of Mercator, and not calculated by any of the Astronomicall Tables.

Though the Longitudes and declinations of the fixed starres set downe in this Table to serue Mercator his Globe, doe not altogether agrée with the great Celestiall Globe, lately set forth by Master Sanderson and by Master Molinaxe, by reason that the Longitudes and declinations of the said starres are more lately calculated, that is to saye, for the yeare of our Lord, 1592. yet it will serue to shew you the way how to exercise your selfe in the said Globe, and thereby you may correct this Table, and make it to agrée in all points with the new great Globe, whereby you shall reape more pleasure then griefe or paine. For I had this Table (as I haue saide before) out of Garceus, and did heere set it downe more for your exercise, and to acquaint you with the fixed Starres that are described in the Celestiall Globe, then for any other purpose.

The vse of the Table next ensuing.

THis Table is deuided into eight collums, The first whereof on the left hande, contayneth the names of the Starres, the seconde the degrées and minutes of Longitude, together with the Characters of the 12. signes: the thirde the degrées and minutes of Latitude both Northerne and Southerne, the North Latitude being marked with the letter N, and the South Latitude with the letter S. the fourth containeth the degrees and minutes of declination both Northerne and Southerne, marked with the letters N. and S. as before. The

fift

fift sheweth the magnitude or greatnesse of the starre, whether it be of the first, second or third bignesse, &c. The sixth containeth the degrées and minutes of the right ascention of the foresaide fixed starres. The seuenth containeth the Characters of the Planetes, signifying the nature and qualitie of the starres. The eight containeth the degrées & minuts of the right ascention of the Ecliptique line and the signes of the Zodiaque.

Here followeth the Table.

Hh

The names of the starres.	The Longitude & place.		The signes.	The Latitude		North & South.
The first starre of the Rammes horne.	27	40	♈	7	40	Nor.
The right shoulder of Cepheus	8	0	♈	69	0	Nor.
The last starre of Eridanus.	22	30	♈	53	30	Sou.
The shoulder of Andromeda.	16	20	♈	24	30	Nor.
The girdle of Andromeda.	24	50	♈	26	30	Nor.
The right side of Perseus	25	0	♉	30	0	Nor.
The head Algol or Meduza.	20	40	♉	23	0	Nor.
The south starre of Pleiades.	23	29	♉	4	20	Nor.
The North starre of Pleiades.	23	10	♉	5	0	Nor.
The Bul's eye.	2	50	♊	5	0	Sou.
The right shoulder of Orion.	23	0	♊	17	0	Sou.
The left shoulder of Orion	12	0	♊	17	0	Sou.
The right shoulder of Aurigа.	24	0	♊	20	0	Nor.
The Goate or Hircus	16	0	♊	22	30	Nor.
The former of the Kiddes	13	0	♊	18	0	Nor.
The latter of the Kidder	13	30	♊	18	0	Nor.
The left foote of Orion.	10	10	♊	31	30	Sou.
The tayle of the little Beare.	21	10	♊	66	0	Nor
The middle starre of Orions girdle.	18	0	♊	24	30	Sou.
Canopus in the shippe Argo.	8	30	♋	75	0	Sou.
The great Dogge.	9	0	♋	39	10	Sou.
The little Dogge.	20	30	♋	16	0	Sou.
The former head of Gemini.	14	20	♋	9	40	Nor
The following head of Gemini.	17	40	♋	6	30	Nor.
The North Asellus.	1	30	♌	3	0	Nor.
The South Asellus in Cancer.	2	20	♌	0	10	Sou.
The Nebulous starre in Cancer	1	20	♌	0	40	Nor.
The shoulder of the great Beare	11	40	♌	49	0	Nor.
The bright starre of Hydra.	21	0	♌	20	30	Sou.
The Lyons heart.	23	30	♌	0	10	Nor.
The Lyons necke.	23	10	♌	8	30	Nor.
The Lyons tayle.	15	30	♍	12	0	Nor.
The middle starre of the great Beares tayle.	9	50	♍	56	0	Nor.
The right wing of Virgo.	3	10	♎	15	10	Nor.

Declination.	No. & South.	Magnitude of the Starres	The right Ascention Degr.	Min.	The names of the Starres by the characters of the Planets	The right ascention of the starres in the Ecliptique beginning the Sign	The Characters of the Signes.
17 20	Nor.	3	23 ♎	0	♂ ♖	25 0	♈
61 0	Nor.	3	317	15	♄ ♃	15 0	♒
41 0	Sou.	1	43	30	♃ ♀	15 50	♉
28 26	Nor.	3	5	0	♀	5 0	♈
33 0	Nor.	3	12	10	♀	13 0	♈
48 0	Nor.	2	43	0	♄ ♃	15 29	♉
39 30	Nor.	2	40	20	♄ ♃	13 0	♉
22 0	Nor.	5	50	10	♂ ☽	23 10	♉
23 10	Nor.	5	50	0	♂ ☽	22 20	♉
15 30	Nor.	1	63	0	♂	4 20	♊
6 20	Nor.	1	83	20	♂ ☿	23 50	♊
4 40	Nor.	2	72	0	♂ ☿	13 0	♊
43 0	Nor.	2	82	0	♂ ☿	22 50	♊
45 0	Nor.	1	71	30	♂ ☿	13 0	♊
40 0	Nor.	4	68	50	♂ ☿	10 28	♊
39 40	Nor.	4	69	0	♂ ☿	11 0	♊
9 0	Sou.	1	73	0	♃ ♖	14 20	♊
86 0	Nor.	3	4	30	♄ ♀	4 30	♈
1 50	Sou.	2	79	45	♃ ♄	20 20	♊
52 0	Sou.	1	94	24	♄ ♃	3 30	♋
16 0	Sou.	1	97	0	♂ ♃	6 30	♋
6 10	Nor.	1	109	30	♂	18 0	♋
32 0	Nor.	2	106	47	☿	15 28	♋
28 30	Nor.	2	110	5	♂	18 20	♋
22 30	Nor.	4	124	0	♂ ☉	1 40	♌
19 20	Nor.	4	124	50	♂ ☽	2 0	♌
20 0	Nor.	neb.	124	0	♂ ☽	1 30	♌
62 30	Nor.	2	161	0	♂	9 30	♍
5 0	Sou.	2	137	0	♄ ♂	14 30	♌
13 30	Nor.	1	145	93	♃ ♂	23 30	♌
21 40	Nor.	2	148	40	♖	26 0	♌
16 20	Nor.	1	171	10	♄ ♀	20 30	♍
56 55	Nor.	2	196	0	♂	17 0	♎
12 30	Nor.	3	189	0	♄ ☿	9 40	♎

The names of the starres.	The Longitude & place.		The signes.	The Latitude		North & South.
The left shoulder of Bubulcus.	10	0	♎	49	30	Nor.
The Rourns hill.	6	30	♎	21	40	Sou.
Arcturus the great starre betwixt Bubulcus his legs	18	0	♎	32	0	Nor.
Spica virginis:	17	40	♎	2	0	Sou.
The middle starre in the front of Scorpio	26	40	♏	1	30	Sou.
The South ballance of Libra	9	0	♏	0	40	Nor.
The North starre of the ballance Libra:	13	10	♏	9	0	Nor.
The left hand of Serpentarius.	27	0	♏	17	0	Nor.
The bright starre of Ariadnes crowne.	5	30	♏	44	30	Nor.
The heart of the Scorpion.	3	30	♐	3	30	Sou.
The head of Hercules	8	40	♐	37	30	Nor.
The head of Serpentarius	15	30	♐	36	0	Sou.
The head of the Dragon	20	20	♐	76	0	Nor.
The bright starre of Lyra	9	0	♑	62	0	Nor.
The Eagle, alias vultur volans.	24	50	♑	29	20	Nor.
The left starre of the taile of Capricorne.	16	0	♒	2	0	Sou.
The following starre thereof:	17	10	♒	2	0	Sou.
The taile of the Dolphin.	8	10	♒	29	30	Nor.
The Fomshant.	28	0	♒	23	0	Sou.
The point of the dart	1	10	♒	39	30	Nor.
The tayle of the Swanne.	0	20	♓	60	0	Nor.
The right thygh of Pegasus.	22	50	♓	31	0	Nor.
The tayle of the Whale	27	0	♓	20	20	Sou.

How to finde out the right and oblique ascention of any starre, and also the ascentionall difference.

Proposition. 32.

THe right ascention of any star is an arch or portion of the Equator, to bee counted frō the first point of Aries according to the succession of the signes, with which portion in a right Spheare any starre both riseth, mounteth to the Meridian, and setteth: and in an oblique Spheare it is a portion of the Equator, wherewith the star is mounted to the Meridian: as for example, in a right Spheare the star called Cor Leonis, that is to say, the hart of the

Lyon

Declination.	No. & South.	Magnitude or greatnes.	The right Ascention	Nature of the starr shewed by the characters of the Planets.	The oblique ascention of the next Ecliptique accompaning the starr	Their Characters of the Signes.
			Degr. Min.			
40 0	Nor.	3	213 0	♄ ☿	5 0	♍
22 30	Sou.	3	176 43	♄	26 20	♍
22 0	Nor.	1	209 0	♃ ♂	1 0	♍
10 0	Sou.	1	195 10	♂ ♀	16 30	♎
21 0	Sou.	3	234 0	♂ ♄	26 30	♍
14 0	Sou.	2	217 0	♄ ♂	9 20	♍
8 0	Sou.	2	223 10	♃ ☿	15 46	♍
3 30	Sou.	3	238 30	♄ ☿	30 0	♍
28 0	Nor.	2	229 0	☿ ☿	27 20	♍
25 0	Sou.	2	241 0	♃ ♂	3 0	♐
15 0	Nor.	3	253 35	☿	14 0	♐
12 50	Nor.	3	258 30	♂ ♀	19 10	♐
52 0	Nor.	3	266 10	♄ ♂	26 30	♐
38 20	Nor.	1	275 20	☿ ☿	5 0	♑
7 30	Nor.	2	210 40	♄ ♂	20 4	♑
18 0	Sou.	3	319 0	♃ ♄	17 0	♒
17 30	Sou.	3	320 10	♃ ♄	18 0	♒
10 8	Nor.	3	304 0	♄ ♂	1 10	♒
33 10	Sou.	1	339 0	☿ ☿	7 0	♓
18 10	Nor.	4	295 0	♂ ☿	23 8	♑
43 30	Nor.	2	307 10	♂ ☿	5 0	♒
25 0	Nor.	2	341 0	♃ ♂	9 30	♓
19 50	Sou.	3	5 35	♄	6 0	♈

Lyon, both riseth, mounteth and setteth with the 145. deg. 30 of the Equinoctiall. But the right ascention of the saide starre in an oblique Spheare, is to be found onely by bringing the said starre to the Meridian, and you shall finde it to bee all one with the right ascention in a right Spheare, for by bringing the starre called Cor Leonis to the Meridian in an oblique Spheare, you shall finde the right ascention thereof to bee all one with that which it had in a right Spheare, that is, 145. degrees 30. of the Equinoctiall. But if you would know the oblique ascention of any star, then hauing set the Globe at your Latitude, bring the star to the East part of the Horizon, & marke what degree of the Equinoctial

riſeth therewith, and that is the oblique aſcention: As for example, the Globe ſtanding at the Latitude 52. bring the ſtarre Cor Leonis, to the Eaſt part of the Horizon, & by ſtaying the Globe there, you ſhall find the 127. degree of the Equinoctiall to riſe with that ſtarre. Now if you would know the aſcentionall difference, that is to ſay, the difference betwixt the right and oblique aſcention, you haue no more to doe but to ſubtract the leſſer out of the greater, and the remainder ſhall be the aſcentionall difference, as in the former example, take 127 degrees out of 145. degrees & 30. and there ſhall remaine 18. degrees 30. and that is the aſcentionall difference, by helpe whereof you may know the encreaſe and decreaſe of the artificiall day and night throughout the yeare in any Latitude, if you obſerue that order which I haue already ſet downe in the firſt part of my Spheare, the 50. Chapter.

To know in what quantitie of time any whole ſigne or any other Arch of the Ecliptique doth riſe or ſet.

The 33. Propoſition.

HAuing ſet the Globe at your latitude, and rectified the Index of the houre wheele by the ſeuenth Propoſition, bring the beginning of any Arch or ſigne to the Eaſt part of the Horizon, and marke what degree of the Equinoctial riſeth therwith, that done, bring the end of the ſaid ſigne or arch to the Eaſt part of the Horizon, and marke there alſo what degree of the Equinoctiall toucheth the Horizon, and ſtaying the Globe there, looke how many houres or parts of houres the Index of the houre-wheele hath runne betwixt the beginning and ending of the ſaid ſigne or arch, and ſo you ſhall know the quantity of that time, you may know it alſo by the number of degrees of the Equinoctial contayned betwixt the beginning and ending of the ſaid ſigne or arch by allowing 15. degrees to an houre, and 4'. to a degree. As for example, ſuppoſing the Sunne to bee in the firſt degree of Taurus, you ſhall find by working according to the rule before ſet downe, that the whole ſigne of Taurus doeth ſpende in riſing

one

one houre 8'. Now if you will know how much time he ſpendeth in deſcending, bring the firſt degree of Taurus to the Weſt part of the Horizon, marking what degree of the Equinoctiall toucheth the Horizon at that inſtant, and alſo to what houre the Inder pointeth, then turne the Globe ſtill Weſtwarde vntill the laſt degree of Taurus meeteth euen with the edge of the Horizon, and then marke againe aſwell the degrees of the Equinoctiall that toucheth the Horizon, as alſo to what houre the Inder pointeth, and you ſhall finde the number of degrees of the Equinoctial to be 42. degrees, which maketh two houres 48. minutes, which is anſwerable to the houre of the houre-whæle: and ſo much time the whole ſigne of Taurus ſpendeth in his deſcention or going downe.

How to know by the Globe what ſtarres doe riſe or ſet euery day Coſmically, Acronically, or Helically.

Propoſition 34.

AS for the threefold Poetical riſing and ſetting of the ſtars, you ſhal find them plainly defined in the firſt part of my Spheare, Chap. 35. but to find out the ſame by the Globe you muſt do thus. Firſt hauing ſet your Globe at your Latitude, and ſought out the place of the ſun for that day, bring the degree of the Sun to the Eaſt part of the Horizon, and ſtay the Globe there, that you may ſee what ſtars do riſe a little before the ſunne, and which riſe together with the ſunne. For thoſe that riſe a little before the ſunne, are ſaid to riſe Helically, and thoſe that riſe together with the Sunne are ſayde to riſe Coſmically, and thoſe Starres that are in the very Weſt part of the Horizon at the riſing of the Sunne, are ſaid to ſet Coſmically. Againe thoſe ſtarres that riſe immediatly after the ſun, doe ſet Helically, that done, turne the degree of the Sunne vnto the Weſt part of the Horizon, and ſtaying the Globe there marke what ſtarres are ready to goe downe with him, for thoſe are ſaide

to set Acronically, and staying the Globe still there in the West, marke what starres at that present do rise in the East part of the Horizon, for those are said to rise Acronically.

To know in what time of the yeare any starre riseth or setteth, either Cosmically, or Acronically.

The 35. Proposition.

HEre hauing set the Globe at your Latitude, and knowing the degree of the Sun, bring the star to the East part of the Horizon, and therewith consider what degree of the Ecliptique the Horizon cutteth at that present, that done finde out the selfe same degree vpon the Horizon in the narrow space of degrees nert vnto the body of the Globe, and right against that degree, you shall finde in what day and moneth that starre doth rise Cosmically, As for example, I would know at what time of the yeare Cor Leonis riseth Cosmically in the Latitude 52. I bring the starre Cor Leonis to the East part of the Horizon, and I finde that the Horizon cutteth the Ecliptique in the 23. degree 30. of Leo, which degree being found againe vppon the Horizon, pointeth to the sixth day of August, so as I conclude that Cor Leonis doth rise that present day Cosmically, for then both hee and the sunne are in a manner in one selfe degree of the Ecliptique; nowe to know the Cosmicall setting of the said starre, turne the same starre to the West parte of the Horizon, and marke what degree of the Ecliptique doth then rise in the East, and you shall finde the same to be the 23. degree of Aquarius, which degree being founde againe vpon the Horizon in the narrowe space of degrees nert to the body of the Globe, contayning the degrees of the Zodiaque, will point to the 31. day of January, at which time the sunne is opposite to the said starre, and therefore it is sayde to go downe Cosmically, because it goeth downe when the Sun riseth. Now to know the Acronicall rising of any star at any time, bring the starre to the East part of the Horizon, and marke therewith what degree of the Ecliptique goeth down in the West at that instant.

ſtant, for the ſunne being in that degrée is oppoſite to the ſtar: As for example, by bringing the ſtarre Cor Leonis to the Eaſt part of the Horizon, you ſhall find that the 23. deg. of Aquarius goeth downe at that inſtant, which degrée being found againe vpon the Horizon will ſhew the day and moneth when the ſtarre riſeth Acronically, and ſo you ſhall finde the ſtarre Cor Leonis to riſe Acronically the 31. day of January. Contrariwiſe if you would know when the ſaid ſtarre ſetteth Acronically, bring the ſaid ſtar Cor Leonis, to the Weſt part of the Horizon, and therewith marke what degrée of the Ecliptique then ſetteth in the Weſt, which degrée being found againe vpon the Horizon, wil ſhew that the ſaid ſtarre ſetteth Acronically the 6. of Auguſt.

Of the Horoſcop and the reſt of the 12. houſes.

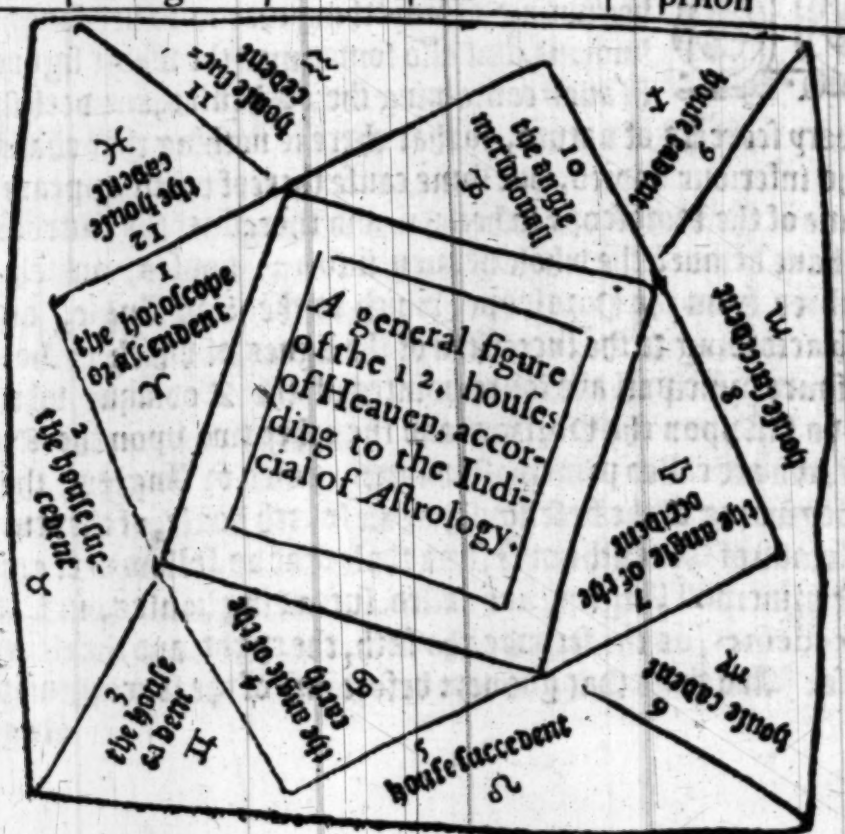
The 36. Propoſition.

THis word Horoſcop doth not onely ſignifie the degrée of the Ecliptique, otherwiſe called the aſcendent, which riſeth aboue the Horizon in the beginning of any thing that is to bee ſought or knowne, but alſo ſometimes the whole figure of heauen containing the 12. houſes, and doth ſhew the very ſecreats of nature, ſo that there is nothing that chanceth to the inferiour bodies, but ſome cauſe thereof doeth appeare by meane of the Horoſcope in heauen, and therefore the Aſtrologians haue deuided the whole heauen into 12. houſes, which are numbred from the Horoſcope, which is the Eaſt Angle, and ſo forth according to the ſucceſſion of the ſignes, of which 12. houſes the foure principall are foure pointes of the Zodiaque whereof two do fall vpon the Horizon, and the other two vpon the Meridian, and are called principall pointes, poles or Angles, that is the beginning of the firſt houſe, of the fourth houſe, of the ſeuenth houſe, and of the tenth houſe, and thoſe that do follow next any of theſe principall Angles, are called ſuccæding houſes, in Latine Succedentes, as the ſeconde, the fifth, the eyght, and the eleuenth houſe. And thoſe that goe next before any of the foure principall

Angles

Angles, are called falling houses, in Latine Cadentes, as the 12 the third, the sixth, and the ninth: and such houses as haue no familiaritie with the Horoscop or ascendent, as the second, the sixth, the eight, and the eleuenth houses are said to bee slow and deiect, all which things this Table here following doth shew, containing the number and names of the houses. and also their significations.

The 12. houses	The names of the houses.		The significations of the houses.
1	Angle	East	life
2	succeeding	the lower gate	gaine
3	falling	the Goddesse	brethren
4	Angle	the bottom of heauē	parents
5	succeeding	good fortune	children
6	falling	euil fortune	health
7	Angle	the West	wife
8	succeding	the higher gate	death
9	falling	God	religion
10	Angle	the middle of heauen	kingdome
11	succeeding	the good spirit	benefactor
12	falling	the euil spirit	prison



How to find out the Horoscop or ascendent at any time of the day or night by the Globe, and thereby to know the 4. principall angles of heauen.

Proposition 37.



First hauing set the Globe at your Latitude, and rectified the Inder of the houre whéle according to the degré of the signe wherein the Sun is that day you séke by the 7. proposition, if it bee in the day time, take with your Astrolabe or Quadrant, the altitude of the Sun. But if it be in the night, take the altitude of some knowne Starre, that thereby you may knowe the houre of the day or night in which you séke the ascendent. But if it happen that neyther Sunne nor Starre is to bee séene that day or night, then learne by some true clocke or watch what houre it is, and hauing set the Inder of the houre whéle at that houre stay the Globe there, and therewith marke what degré of the Ecliptique riseth in the East parte of the Globe aboue the Horizon at that instant, and that degré is the Horoscop or ascendent for that houre. As for example, you woulde finde out the ascendent the 16. of June 1590. at 8. of the clock in the forenoon, at which day the Sunne is in the 4. degré of Cancer, here hauing first set the Inder of the houre whéle at that houre by staying the Globe there, you shall finde that the 21. degré 30'. of Leo is the ascendent, which is the East angle or first house, wherby you may also at that instant find out the other thrée angles, that is, the west, South, & North angles, for the opposite point of the Zodiaque to the ascendent is the West angle or seuenth house. And that degré of the Zodiaque, which is at that instant right vnder the Meridian aboue heade in the South angle or 10. house, and the opposite point to that beneath, is the north angle or fourth house, for hauing found the ascendent, which is the East angle or first house to be the 21. degré, 30. minutes of Leo, the West angle must néedes be the 21. degré 30. minutes of Aquarius. Againe the south angle or 10. house is the 8. degré of Taurus, and the opposite

posite point that is in the North Angle or fourth house which is the 7. of Scorpio.

How to erect a Figure by the Globe according to Regio Montanus his way which is called the reasonable vvay, and is counted the best of all others.

Prop. 38.

FIRST you must find out the degree of the ascendent as is taught in the last Chapter, which is alwaies the first house, then staying the Globe with some prettie wedges of woode beeing thrust betwixt the Horizon & the body of the Globe, marke there what degree of the Equinoctiall doth touch the Horizon at that instant, and number from thence vpward vppon the saide Equinoctiall thirtie degrees, to the ende of which thirtie degrees, bring the semicircle of position beeing first fastened in his due place vpon the East side of the Horizon, and looke what degree and signe of the Zodiaque the circle of position cutteth at that present, and that degrè shall bee the twelfth house: then number againe other 30. degrees vppon the Equinoctiall vpwardes towards the brazen Meridian, and to that bring the semicircle of position, marking what degrè of the Zodiaque the said semicircle cutteth, and that shall be the 11. house, that done, looke what degrè of the Zodiaque is right vnder the brazen meridian aboue head, and that shall bee the 10 house. Then hauing set the semicircle of position vpon the West side of the Globe, number from the brazen Meridian Westward vpon the Equinoctiall other 30. degrès, to the end whereof bring the semicircle of position, and marke what degrè of the Zodiaque the circle of position cutteth, and that shall bee the 9. house, then from thence downeward number vpon the Equinoctiall other 30. degrees, to the end whereof bring the Semicircle of position, marking there what signe and degree of the Zodiaque the said Semicircle cutteth, and that shall be the 8. house. Now hauing these fiue houses, the opposite points of the said fiue houses will shew you the other fiue houses,

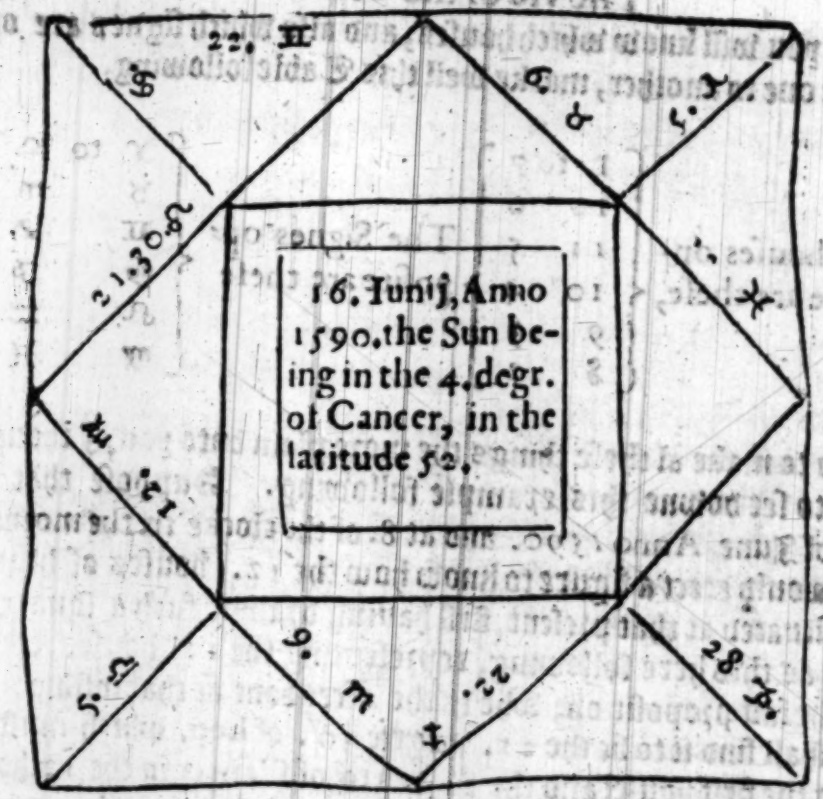
and

and if you will know which houses, and also which signes are opposite one to another, marke well this Table following.

The houses opposite are these,	1	to 7	The Signes opposite are these	♈	to ♎
	12	6		♉	♏
	11	5		♊	♐
	10	4		♋	♑
	9	3		♌	♒
	8	2		♍	♓

And to make al these things the more plain vnto you, I thought good to set downe this example following. Suppose that the 16. of June, Anno 1590. and at 8. of the clocke in the morning you would erect a figure to know how the 12. houses of heauen are situated at that present, first hauing drawne such a square figure as this here following, representing the 12. houses, learne by the last proposition, who is the ascendent at that instant, and you shall find it to be the 21. degree 30'. of Leo. which must bee set in the first house, and the 28. degree of Cancer in the 12. house and the 22. degree of Gemini in the 11. house, and in the 9. degree of Taurus in the 10. house, and the 5. degree of Aries to be in the 9. house and the 12. degree of Pisces in the 8. house. Nowe the opposite house to the first house or ascendent is the 7. house which is the 21. degree 30'. of Aquarius, for the opposite signe must alwayes haue like number of degrees, then the opposite to the 12. house is the 6. house, which the 28. deg. of Capricorne, and the opposite to the 11. is the 5. house, which is the 22. degree of Sagittarius, and the opposite to the 10. house is the 4. house, which is the 9. degree of Scorpio, and the opposite to the 9. house is the 3. house, which is the 5. degree of Libra, and the opposite to the 8. house is the second house which is the 12. degree of Virgo, all which things this figure here following doth plainely shew. And if you would know what planets should be placed in euery house, you must learne that out of the Ephemerides, or out of some of the Astronomicall Tables.

Now



Now because most men that do shew the vse of the Globes, do also teach therein how to finde out the latitude and longitude of any region, I thought good therefore to set downe here some of their manifolde wayes touching the finding out of the same, notwithstanding that I haue already written something thereof in the second part of my Spheare, in the 8. 9. 10. & 11. chapters.

How to know the latitude of any place or region by any of the fixed starres described in the Globe.

Proposition 39.

TAke in the night season with your Astrolabe the Meridian altitude of some knowne starre that is to be founde in the Globe, then hauing brought the starre vnder the brazen Meridian, turne the Meridian vp and downe in the nickes of the Horizon, vntil the same Starre haue the said

said altitude in the brazen Meridian, which you found it to haue in the firmament by your Astrolabe, that done, number the degrees of the Meridian contayned betwixt the Pole and the Horizon, and that is the latitude of that place.

Another way to find the eleuation of the Pole.

The 40. Proposition.



HAuing brought the globe into an open place where the Sunne shineth at noontide, and placed the same right North and South as is taught in the first chapter, set a needle in the degree of the Sunne, and bring the same to the brazen Meridian, not ceasing to turne the same Meridian vp and down in the nicks of the Horizon, vntill the needle cast no shadow at all, and there staying the Globe, looke how many degrees the Pole is eleuated aboue the Horizon, for that is the latitude of that place.

A third way to find out the latitude of any place without taking the Meridian altitude of any Starre.

The 41. Proposition.

TAke at any houre the altitude of 2 knowne starres, and such as are to be found in the Globe at one self instant whereof the one must bee situated towards the East, and the other towardes the West, then turne the Globe together with the Meridian vp & downe in the nicks of the Horizon, vntill you finde by helpe of the quarter of altitude ech starre to haue the selfe same altitude in the Globe, that it had in heauen, which being done, looke howe many degrees the North Pole is eleuated aboue the Horizon, and that is the latitude of that place. But if you would know the latitude of any place that is towardes the South Pole, then you must first place the South Pole aboue the Horizon, and then worke as before.

A fourth way to find out the latitude of any region by any knowne fixed starre or Planet that may be seene.

Proposition 42.

FIrst take his Meridian altitude, and then learne to know eyther by the Globe or by some table his declination, which if it bee Northerne you must subtract the same from the Meridian altitude, if Southern adde it to the Meridian altitude, so shal you haue the eleuation of the Equinoctiall, which being subtracted from 90. the remainder shall bee the latitude of that place, as for example I finde the Meridian altitude of Oculus Tauri to be 53. degrees, 50'. 32''. and his declination Northward to be 15. degrees, 50', 32''. which declination being subtracted from the Meridian altitude, there remayneth 38. degrees, and that is the eleuation of the Equinoctial. which being subtracted from 90. there remayneth 52. for the latitude of that place.

Hitherto I haue set down the chiefest propositions that are to be done by the Globe, touching the Sun and the fixed starrs: and lastly shewed how to find out ỹ latitude of any place, wherfore now I thinke good to shew you how to find out the place of the Moone, and of euery one of the rest of the Planets in the Globe by helpe of the Ephemerides, and thereby to know when euery planet ryseth and setteth, and first of the Moone.

A briefe description of the diurnall table set downe in Stadius his Ephemerides, together with the vse thereof.

Proposition 43.

BVt for as much as the diurnall Table of the Ephemerides shewing the dayly motion of the Planets is very needfull to serue diuers turnes, I thinke it not amisse here briefly to describe ỹ same, & specially that of Iohannes Stadius whose diurnal table or Almanack beginning

at

at the 202. page of his booke, and at the yeare of our Lord 1583 continueth to the yeare 1606.

Of which Table euery page on the left hand is diuided into 9. collums. In the first collum whereof on the left hand are set down the dayes of the moneth, first the Gregorian dayes, according to the Romane account, and next to that the dayes of the moneth according to our English account, then in the front of euery other collum are set downe the characters first of the Sunne, and then of other the fiue Planets that is to say, of the Moone, Saturne. Iupiter, Mars, Venus, Mercurie, & last of all, the head of the Dragon figured thus ☊ And right vnder these seuen Planets, and also vnder the head of the Dragon are set downe the signes and degrées wherein euery of these is euery day of the moneth throughout the yeare at noonetide, and in the foote of the sayd Table is set downe the Latitude of euery one of the 5. Planets, proceeding by the dayes of the moneth deuided into three partes. And in the margent of euery left page are set downe the chiefest feastes and Saints dayes that fall in euery moneth throughout the yeare. Moreouer, there is a Table on the right hand right against the left Table, in which are set downe first the dayes of the moneth, and then what coniunction or any other aspect the Moone hath with any of the other fiue Planets, that is, with the Sunne, with Saturne, with Iupiter, with Mars, with Venus and with Mercurie, which Planets are set downe in the front of the saide Table, and vnder them the Characters of such aspectes as the Moone hath that day with any of the other Planets. The Characters of which aspects are these here following.

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Whereof the first signifieth a coniunction, the second an opposition, the third a trine aspect, the fourth a quadrat aspect, and the fift a sextile aspect.

Two Planets are said to bee in a coniunction when they are both in one selfe signe. And to be in an opposition when they are in two seuerall signes opposite one to another. For then they be distant one from another 6. signes. And they are saide to bee in trine aspect whē they be distant one from another by four signes. And to bee in a quadrat aspect when they are distant one from a-

nother by three signes. And to be in a sextile aspect when they are distant but two signes one from another.

How to finde out the place of any Planet by the Ephemerides.

Proposition. 44.

NOw to find out the place of any Planet, or of the head of the Dragon by this diurnall Table, you must first seeke out the day of the moneth in the first collum of the left table, right against that on your right hand in the said left Table, you shall finde in the common angle right vnder the Planet or Dragons head (which so euer of them you seeke) the signe and degree wherein the said Planet or Dragons head is the said day at noonetide.

And to finde out the aspects which the Moone hath with any of the Planets the same day, you must resort to the other table on the right hand, obseruing like order as before.

The example.

As for example the 21. of Aprill 1592. which is the first of May, according to the Romain account, I find by the table on the left hand, the Sunne to be in the 10. degree 50. of Taurus, the Moone to be in the third degree, 47. of Capricorne, Saturne, to be in the 8. degree, 10. of Cancer, Iupiter to be in the 18. degree 28. of Sagittarius, Mars to be in the 12. degree, 6′ of Gemini, Venus to be in the 2. degree, 0′. of Aries, and Mercurie to be in the 6. degree, 20. of Taurus, and the head of the Dragon to be in the 29. degree, 45. of Gemini.

And right against this in the Table on the right hande you shall finde the Moone to be in a trine aspect with the Sunne, to be in an oppo sition with Saturne, to be in a trine aspect with Mercurie.

Thus

Thus hauing briefly shewed you the vse of the diurnall Table, I wil shew you now how to find out the latitude of the Moone as well North as South, by help of Stadius his Table, set downe in the 112. page of his Ephemerides, and first I will briefly describe the said Table.

A briefe description of the Table of *Stadius* set down in the 112. page of his Ephemerides to find out thereby the dayly Latitude of the Moone, be it North or South, together with the Canon or rule thereof planely declared by example.

Proposition. 45.

THis Table is diuided into eight collums, whereof the first on the left hande contayneth the degrees of euery signe set downe in the front of the Table, which degrees are to bee counted descending from one to 30. for so many degrees there be in euerie signe: and the last collum on the right hand containeth the like number of degrees belonging to the signes set downe in the base or foote of the sayde Table, and this number ascendeth vpward from one to 30. and for that purpose it would not haue beene amisse to haue set ouer each head of those two collums this word gradus, next vnder the word Signa. Any of the other sixe collums the first three on the left hand doe containe the degrees, minutes and seconds of the North Latitude, and the other three towards the right hand do containe the degrees, minutes, and seconds of South Latitude. Moreouer, the 12. signes are to be numbred in the front from the thirde collum on the left hand from 1. to 5. forwarde toward the right hand, and at the foote from 6. to 11. backward towards the left hand, set downe in arithmeticall figures.

The rule or Canon together with a plaine example shewing the vse of the Table.

FIrst knowing the day of the moneth, resort vnto the diurnall Table of motion of the Planets in the Ephemerides, and hauing there found out the motion or place of the Moone, and also of the Dragons heade answerable to the day wherein you seeke, subtract the place of the Dragons head from the place of the Moone, which is easily done so often as the arke of the Moone is greater, that is to say, containeth more signes and degrées than the arke of the Dragons heade, beginning your account in both arkes from the first point of Aries. But if the arke of the Moone be lesser than the ark of the Dragons head, so as you cannot make your subtraction, then you must add to the place of the Moone 12 signes, which is 360. degrées, and you must adde also thereunto the number of so many signes as are contained betwixt the first point of Aries, and the first point of that signe wherein the Moone is at that present, which signe it selfe is not to be numbred, and when you come to take out of that whole summe the place of the Dragons head, you must first adde to the saide place of the Dragons head the number of so many signes as are contayned betwixt the first point of Aries, and the first point of that signe wherein the Dragons head is at that instant, but not the signe wherein it is, and then hauing made your subtraction, remember alwayes to take out of that remainder 90. degrées, which is three signes, so oft as you haue neede to adde 12. signes to the place of the Moone, and not otherwise, and with that remainder you must resort to the foresaid table of the Moones latitude, as for example.

The Example.

Suppose that you would know what Latitude the Moone had the first of Nouember 1590. here resorting to the diurnall Table of the Ephemerides, you find according to the day proposed, the place of the Moone to be in the 16. degrée 49. of Taurus, and the

place

place of the Dragons head to be in the 28. degree 1′4. of Cancer. Now according to the rule before giuen, you must take the place of the Dragon heere, which is 28. degrees, 1′4. of Cancer out of the 16. degree 4′9. of Taurus, which is the place of the Moone, and because you cannot take the greater summe out of the lesser, you must adde to the lesser summe 12. signes, which make 360. degrees, and also one signe, for Aries going next before Taurus, in which signe the Moone is, so shal you make the whole summe to bee 13. signes 16. degrees 4′9. out of which summe you must subtract the Dragons head, which with the signes that goe next before Cancer, counting from the first point of Aries, do make 3. signes 28. degrees, 1′4. which being subtracted out of 13. signes, 16. degrees, 4′9. there remaineth 9. signes, 18. degrees, 3′5. out of which you must also subtract 90. degrees, which is three whole signes, and so you find the remainder to bee 6. signes, 18. degrees 3′5. with which last remainder you haue to enter into the Table of the Moones Latitude, in the foote whereof you shall finde 6. signes, and in the last collum on the right hand 18. and in the next collum towards the left hand, and in the common angle answerable as well to the saide 18. degree, as also to the 6. signes, you shall find the Latitude of the Moone to be 4. degrees, 4′5. and 17″. (which seconds may be verie wel omitted) and her Latitude to be South. But now because there are 3′5. more annexed to the 18. degrees of the foresaid remainder, you must find out a proportional part answerable to those minutes which is to be done thus.

Take out of the Table the whole Latitude aunswerable to 6. signes and 19. degrees, which is one degree more, so as nowe the Latitude of the Moone is 4. degrees, 4′3. omitting the seconds. Then subtract 4. degrees 4′3. out of 4. degrees 4′5. and and there remaineth 2′. Now to find out a proportionall part answerable to the former 3′.5. you must say thus. If 6′0. require 2′. what shall 3′5. require? and the quotient yeeldeth 1′.1″0. which being subtracted out of 4. degrees 4′5. there will remaine 4. degrees 4′4. and so much was the South Latitude of the Moone at that present day.

How to know the true place of the Sun or Moone, or of any other planet euery houre of the day throughout the yeare.

Proposition. 46.

BVt now because that to finde out the true place of the Moone or of any other Planet in the Globe to worke thereby certainely and truely, it is not inough to know their places in the Zodiaque at noonetide, vnlesse you know the same at the very houre in which you seeke. Stadius teacheth a briefe rule to find out the true place of any Planet at what houre so euer you desire by helpe of a short Table set downe in the 109. page of his Ephemerides, which rule & Table he borrowed of Reinholdus. And this Table consisteth of 3. collums, in euery front whereof are set first degrées, minutes, seconds, and thirds, & vnder them minutes, seconds, thirds, and fourths. And note that the first row of numbers on the left hand signifieth sometime degrées, and sometime minutes, either of which doe extend in this Table to 60. and to 61. right against which row in euery collum is set down on the right hand the proportionall part for one houre, the rule is thus.

The Rule.

First finde out by the Ephemerides the place of the Planet wherein it is at noonetyde the same daie that you seeke, and also the place of the same Planet, wherein it is the next day following at noone, and subtract the lesser out of the greater, if the two places at noonetyde be still in one selfe signe, but if the two places be in two seuerall signes, then you must count how many degrées of the Ecliptique the one place is distant from the other, and that shall be the difference, with which difference you must resort to the Table, and right against that on the right hande in the same collum wherein you found the difference, you shall also find the proportionall

portionall part for one houre, as by this example you shall more plainely vnderstand.

The Example.

Suppose then that you desire to knowe the true place of the Sunne or of the Moone, or of any other Planet at fiue of the clocke in the after noone the 30. of December 1591. at which day you find the Sunne at noonetyde to be in the 18. degrée, and 7 minutes of Capricorne, and the next day at noone to be in the 19. degrée and 8′. of the same signe, the difference whereof you finde by subtraction to be one degrée and one minute, with which difference you must enter into the table, and séeking for one degrée in the first collum on the left hande, you finde next vnto that on the right hand 2′. 3″ 0. then for one minute which before was named one degrée, you finde next vnto it 2″. 3‴ 0. which being added to the former summe last found, maketh 2′. 3″ 2. 3‴ 0. which is the proportionall part for one houre. Then hauing multiplyed that by 5. houres to serue 5. of the clocke in the afternoone, you shall find the product to be 1′ 2. 4″ 2. 30‴. which being added to the first Meridian place, which is 18. degrées and 7. minutes of Capricorne, maketh in all 18. degrées 1′ 9. 4″ 2. 30‴. And remember that if your difference be onely minutes, then the body of the Table doth shew the proportionall part. But if the difference doth containe degrées, then the fourths must bee made thirds, and the thirds secondes, the secondes minutes, and the minutes degrées. And this table serueth for the 7. Planets for euer. Notwithstanding Stadius setteth downe another Table to finde out thereby the proportional mouing of the Moone seruing as wel for houres as for minutes of houres, which table beginneth at the 144. page, and endeth at the 184. page of his booke.

In the front of which table in euery page are set downe the differences of the two places of the Planets which you haue found by subtracting the lesser out of the greater, if the planet be at both noonetides in one selfe signe, but if she be at the two noontides in two seuerall signes, then such difference is to bee accounted vpon the Ecliptique line, to know how many degrees the one place is

distant from the other, and as for the minutes, if there be any, you may know the difference thereof by subtracting the lesser number out of the greater. And in the outermost collum on the left hande are set downe the houres and minutes marked in the foote with the letter H. signifying houres, and vnder that with the letter M signifying minutes, whereof the houres proceede but to 24. but the minutes extend to 60. which make one houre proceeding by euen numbers in this sorte. 1. 2. 4. 6. 8. &c. and therefore not finding that houre or minute which you seeke in the said collum, you must take the next number which is lesser by one, and so make it vp by adding the first and onely adde one vnto it, and in each common angle you shall find the proportionall part that is to bee added to the first place of the Planet answering to the day of the moneth wherein you sought. All which things you shall more plainely vnderstand by this one example.

The example.

Suppose then that you would knowe the true place of the Moone at 5. of the clocke. 17. in the afternoone the 28. of December 1591. and looking in the Ephemerides you find the place of the Moone to be the same day at noontide in the 26. degree 12. of Libra, and the next day at noontide to be in the 8. deg. 17. of Scorpio. here by numbring how many degrees are contained in the Ecliptique line betwixt those two places, and by subtracting the lesser number of minutes out of the greater, you shall finde the difference to be 12. degrees 5'. with which difference you must resort to the Table of proportionall partes, and there hauing found the said difference in the front of the 13. page of the said table, look in the first collum on the left hande, for the houres and minutes according to the rule before set downe. As heere in this example, because you cannot find 5. houres, you take foure, right against which on the right hand in the common angle you shall find 2. degrees 0'. 5''. 0. then for one houre to make the 5. houres, you shall find in the common angle 3'. 0. 1''. 2. that done, seeke out the 17. in the first collum, which number not being there you must take 16. against which in the common angle you shall find 8'. 3''. 20'''. and

for

for the one minute which is to be added to 16. you shall find in the common angle against that one minute 30″.12‴. and by adding all these summes together, you shall find the proportional part to be 12.degr.39′.35″.32‴. which being added to the place of the Moone at noone tide first found in the Ephemerides, maketh in all 28.degrees, 51′.35″.32‴. of Libra, which is the true place of the Moone for that houre. But you haue to note that the denominations of the numbers contained in the common angles of proportional parts be not alwaies like, for when they are to answer houres then the first number on the left hand in euery angle signifieth degrees, and the rest minutes & seconds, but if they haue to answere minutes of houres, then the first numbers doe signifie minutes, and the rest seconds and thirds, as you may easily percepue by examining the former example. But now to returne to my first intention, which was to shew you how to finde out the true place of euery Planet in the Globe, you haue to vnderstand that hauing found out the true place of any planet at the day and houre wherin you seeke by such meanes as is before taught, then resort to the celestiall Globe, and hauing set the same at your latitude, and also rectified the houre wheele according to the day wherein you seeke. Suppose that the 26. of May 1592. you would know in what part of the Globe the Moone is to be found at 5. of the clock in the afternoone. Here first you must know her place at noone the same day, which is the 14. degrees, 28′. of Aries, and also her place the next day at noone, which is the 29. degree 0′. of the same signe: Now by taking 14.degrees 28′. out of 29.degrees, you shal finde the remainder to be 14. degrees, 32′. with which difference you must resort to the table set downe in the 109. page. And by working as before is taught, you shal finde her place or longitude to be at fiue of the clocke in the 17. degree 23′.6″.43‴. of Aries, which being counted vpon the Ecliptique line of the Globe, lay your semicircle of longitude and latitude to that point, and hauing learned her latitude by helpe of the Table of latitude before mentioned, by which you shall find her latitude to be at that time 4.deg 46′. to the southward, then hauing counted that latitude vpō the semicircle of longitude & latitude, make there a marke vpon ẏ Globe, for that is her very place at that instant, that is to

say,

say at 5. of the clock in the afternoone the 26. day of May 1592.

Now if you would know when she riseth and setteth, you haue no more to do but to bring her place before marked on the Globe vnto the Horizon on the East part, and the inder of the houre whéle being rectified as is before said, will shew the houre of her rising aboue the Horizon, and by bringing her place to the West part of the Horizon the Inder will shew the houre of her setting, and by bringing her place to the brazen Meridian, you shal know at what houre she is full South. The like tables you shall finde also in Stadius to find out the true place of euery other Planet at any houre, as of Saturne, Iupiter, Mars, Venus, and Mercurie, which Tables do beginne at the 128. page, and end at the 143. page of his booke, the order of working by which Tables is like in euery respect vnto that of the Moone last taught. By which Tables you may finde out the true place of any other Planet in the Globe at any houre of the day or night, and thereby to know the houre of his rising and setting if you rightly obserue the rules before taught touching the vse of the foresaid Tables. And note that you may find out the place of the Moone by the Globe without the helpe of any Ephemerides, by such waies as here doe follow.

How to finde out the place of the Moone by the Globe, when she is aboue the *Horizon*, without the helpe of any Ephemerides or other *T*able whatsoeuer.

Proposition. 42.

HAuing set the Globe at your latitude, and placed it so as it may rightly answere the foure quarters of the world, take the altitude of the Moone with your Astrolabe or quadrant, and marke wherewith whether she be at that present East, or West, that is to say on this side of the Meridian, or beyond the Meridian, that done, take the altitude of some fixed star, which you know, and is to be found in the Globe, and also at that time is aboue the Horizon, marking therewith in what part of the firmament the said

Starre

Starre is, & with your crosse staffe take the distance betwixt the moone and that Starre. Then hauing these three things, that is, the altitude of the Moone, the altitude of the Star, and also the distance betwixt the Moone and the knowne starre. Moue the globe together with the quarter of altitude to and fro vntill you haue made ỹ Moon to haue the same altitude & like place in the globe, that you founde it to haue in the firmament, and there make a marke vpon the Globe. Then lying the quarter of altitude towardes the Starre, that the Star may haue the like altitude and like place in the Globe that it had in the firmament, and there hauing staied the Globe that it may not moue, take with your Compasse vppon the Equinoctiall the distance betwixt the Moone and the starre before found by the crosse staffe, and keeping your compasses at that wideneste, put the firme foote of your Compasses in the fixed Star, and cease not to moue the other foote together with the quarter of altitude towards the mark of the Moones altitude, vntil you make them to meet, for there is the place of the Moone.

Another way to finde out the place of the Moone without taking the altitude of any starre.

Proposition. 48.

SEeke by your crosse staffe to knowe the distance betwixt the Moone and any two starrs that you know & are to bee found in ỹ globe. That done, drawe vpon the globe on either starre an obscure circle according to the distance of the Moone from eyther of those two starrs, which two circles will cut or crosse one another but in 2. points, the one whereof is the place of the Moon, and which of these places it should be, your eye will easily tell you. And by this meanes it were no hard thing (as Gemma Frisius saith) for our sea men in these daies to finde out all the starrs that be in the nether Hemisphere and were vn-

known

knowne to Ptolomie and to the other ancient Astronomers, and to cause them to be set down in the Globe, yea and by this art the places of the rest of the Planets may be found out as well according to their latitude as longitude.

Moreouer Gemma Frisius saith, that by knowing the true place of the Moone in the Zodiaque, you may also find out thereby the vnknowne Longitude of any Region.

How to find out the Longitude of any Region. The 49. Proposition.

HAuing found out the place of the Moone in the Zodiaque, you must first know the very houre of her being in that place, and then learne by some Ephemerides, or by the Tables of Alphonsus, at what houre the Moone doth enter into the selfe same degree of the Zodiaque in some other Region or Town whose longitude you already know, and hauing reduced the houres to 24. take the lesser number of houres out of the greater, the remainder wherof must be reduced out of houres & minutes into degrees thus: Multiply the houres by 15. & the minutes of houres by 4. so shall you haue the degrees of the Equator contained betwixt the two Meridians. And such distance so intercepted is called the difference of Longitude, which difference you must adde to the knowne Longitude if the houres in that place were more in number, but if the houres were lesse in number, then you must subtract the foresaid difference frō the knowne longitude, so shal you collect the vnknown longitude of that place or Region which you seeke, and how far it is distant from the fortunate Iles.

Another way to find out the vnknown Longitude of any place by the Globe. The 50. Proposition.

HAuing set the Globe at your latitude and rectified the houre wheele by the seuenth Proposition, bring the place whose longitude you knowe to the brazen Meridian, and direct the Inder of the houre wheel to that houre

houre in which the Moon doth occupie the former defined place in that Region or Towne: that done, leaue not to turne the Globe vntill the Index of the houre-wheele come to that houre in which you ſought the vnknowne place of the Moone, and the degrées of the Equator which the brazen Meridian cutteth, wil ſhew the vnknowne longitude of the place which you ſéke.

To the ende of this Treatiſe I haue thought good to adde a bréefe deſcription of the two great Globes lately ſet forth firſt by M. Sanderſon, and then by M. Molineux, and therewith to ſet down a bréefe deſcription of Sir Frances Drake his firſt voiage into the Weſt and Eaſt Indies, and alſo the voyage of M. Tho. Candiſh, both whoſe voiages and what courſe they held are to be ſéne by helpe of two lines drawne on the terreſtriall Globe, of which lines the one is redde ſhewing the voyage of Sir Frances both outward and homeward. And the other line is blew ſhewing in like manner the voyage of M. Candiſh.

A briefe deſcription of the two great Globes lately ſet forth firſt by M. Sanderſon, and then by M. Molineux.

THeſe Globes do differ in a maner nothing at all from the Globes of Mercator touching the circles before deſcribed, but only in the Horizon, for the Horizon of theſe great Globes is diuided into 13. ſpaces as followeth.

Whereof the firſt narrow & innermoſt ſpace next vnto the bodie of the Globe, contayneth the degrées of the Zodiaque.

The ſecond containeth the numbers of the ſaid degrées proceeding from 10. to 30. in euery ſigne.

In

In the third space are set down the names and the characters of the 12. signes, and also the characters of the Planets that gouerne the said signes.

In the fourth space are set downe the letters of the daies of the weeke.

In the 5. and 6. are set downe the numbers of the dayes and names of the monethes according to the auncient Calender.

In the seuenth the festiuall dayes.

In the 8. and 9. space the number of the daies and names of the monethes according to the new Romain Calender.

In the 10. & 11. are set down the numbers of the daies & names of the monethes according to the true Kalender lately calculated by a most excellent Mathematician & mine old acquaintance M. Dee of Mortlake, as I coniecture by the letters I. D. set downe vpon the said Horizon.

In the 12. are set downe the English names of the 32. Rombes of windes of the Mariners compasse.

In the 13. and outermost space are set down the Latine names of the said 32. windes.

But the Mappe which couereth M. Molineux his Terrestrial Globe, differeth greatly from Mercator his terrestriall Globe, by reason that there are found out diuers new places aswel towards the North pole, as in ẏ East & west Indies which were vnknown to Mercator. They differ also greatly in the names, Longitudes, latitudes and distances of such places as haue bẽn heretofore set down not only in Mercators globe, which was made many years since, but also in diuers Maps more lately made, but who goeth nighest the truth I dare not iudge, because I was neuer in those places. But as touching the map of stars which couereth the celestiall Globe of M. Molineux, I do not finde it greatly to differ from that of Mercator, sauing that M. Molineux hath added to his celestial Globe certain Southerne images, as the Crosse, the southerne Triangle, and certain other stars, wherof some do signifie Noes Doue, & others do signifie the image called Polophilax, the images whereof are not here set downe, but you shall find them described in Plancius his Map, made in the yeare 1592. whose longitudes, latitudes, and declinations, how truely they

are

are set downe in the said Globe or Map, I am not able to iudge. He setteth downe also two cloudes nigh vnto the South pole, but not the vse therof. Moreouer to this briefe description of M. Molineux his two Globes, I thought good to adde the first voyage of Sir Frances Drake, & of M. Thomas Candish, set forth by two lines, the one red, and the other blew described in the Terrestriall Globe of the said M. Molineux, and also how farre Sir Martin Furbosher sailed Northward, as followeth.

The first voyage of Sir Frances Drake by sea vnto the West and East Indies both outward and homeward.

IN the great terrestrial Globe lately put forth by M. Sanderson and by M. Molineux, the voyage aswell of Sir Frances Drake, as of M. Thomas Candish is set downe, and shewed by helpe of two lines, the one red, and the other blew, whereof the red line procéding first from Plymouth, doth shew what course Sir Frances obserued in all his voyage, aswell outward as homeward, and the blew line procéding also from Plymouth, sheweth in like manner the voiage of M. Candish, and in that Globe is also set downe how far Sir Martine Furbosher discouered towards the North parts. But first I will describe vnto you the voyage of Sir Fr. Drake that worthy Knight and most noble Neptune, according as that red line directeth in the said Globe.

First parting from Plymouth he sayled with a North North-east winde to an Ile called *Mogodore*, vppon the coast of *Marocco*, which place is not named in M. *Molineux* his Globe, and that place hauing in North Latitude 32. degrées, is distant from Plymouth according to that course, which the redde line sheweth 420. leagues. In this Ile he built a little Pinnis or shallop, and from thence he sayled to Cape Dalguere which is further Southward, and hauing in North Latitude 30. degrées, is distant from *Mogodore* about 40. leagues, and from thence hee sayled to the Iles Canariæ, which are somwhat more westward, and hauing 27. degrées 30′. in North Latitude, are distant from

the

the Cape Dalguere about 100. leagues, & from thence he sayled to Capo Blanco, which is more Westernly, and hauing in North latitude 21. degrées, is distant from the Canaries 130. leagues and somewhat more, and from thence he sailed to the Iles of Capo Verde, which hauing in North latitude about 15. degrées, are distant from Capo Blanco about 140. leagues. And frō thence to the great Cape of S. Augustine, which hauing in South latitude about 8. deg. is distant from Capo Verde 500. leagues, & from thence he sayled more Westernly vnto ẏ mouth of the riuer called Rio de Platta, which hauing in South Latitude 36. degrées, is distant from Cape Saint Augustine 760. leagues, and from thence to the Port Saint Iuliano, hauing in South latitude about 50. degrées, whereas one Doughtie was executed for conspiracie, and this Port is distant from Rio de Platta 370. leagues. And from thence he sailed to the Cape Virgine Maria, which hauing in South latitude 52. degrées 30. is distant from Port S. Iulian 50. leagues, and from thence striking in betwixt the Ile, whose Northeast Cape is called the Ile of the name of Iesus, and the Port Famine, he entred into the straight Magellane, which hauing in South Latitude 53. degrées 30. is distant from the Cape Virgine Maria 60. leagues, and from thence hee passed through the Magellane straites to the Cape de Sancto spirito, which is a Cape of the South land, hauing in South latitude 52. degrées 20. and is distant from Cape Virgine Maria about 160. leagues, from thence he sayled somewhat Westernly about 20. leagues, & there fetching a turne about certain Ilands called Las Anegadas, he tooke his course Northward alongst the West coast of America vnto ẏ Ile Lima, which hauing in South latitude 12. degrées, is distant from the Ilands called Las Anegadas 840. leagues, and from thence he sayled still Northwarde vnto Cape Guija, which hauing in South latitude 6. degrées 10 is distant from ẏ Ile Lima 160. leagues, from thence stil Northward he sailed to Cape S. Francesco, which hauing in North Latitude 1. degrée 30. minutes, is distant from Cape Guija 170 leagues, from thence he sailed stil Northernly to the Cape Mondecino, which is in the land called Quiuira, and this Cape hauing in North latitude 40. degrées is distant by ẏ course from

S. Fran-

S. Francesco 1740. leagues, from thence he sayled still Northward vnto a certaine Bay in the West part of Quiuira, which he named Noua Albion (that is to saye) new Englande hauing in North Latitude 46. degrées, and is distant from the Cape Mondecino 140. leagues. And this was the furthest part of his voyage outward, in which voyage hee sayled in all 5780. leagues, and from this Bay Sir Frances himselfe (as I haue heard) was of very good will to haue sailed still more Northward, hoping to find passage through the narrow sea Anian, which sea is not set downe by M. Molineux in his Terrestriall Globe as a straight, but rather as a maine Sea, bearing in bredth 400. leagues, and so from thence to haue taken his course Northeast, and so to returne by the Iles Crocklande and Groynlande into England, but his Mariners finding the coast of Noua Albion to be very cold, had no good wil to sayle any further Northward, wherfore Sir Frances was faine to come backe againe Southward to Mondecino, which (as hath beene said before) is distant from the foresaid Bay of Noua Albion 140. leagues. From thence he sayled in a manner right Southeast to the Iles Moluccas & touched at the Iles Terenate, Tidori, Machian, and Motill which are nigh vnto the Ile Gilolo, which is right vnder the Equinoctiall, amongest which Iles he remained a certaine time, of which Ilands the Ile called Terenate hauing about one degrée 30. of North Latitude, is distant by that course from the Cape Mondecino 1140. leag. and from thence hee sayled Southwest vntill he came to the West end of the Ile Iaua maior, which hauing in South Latitude nine degrées 30. minutes, is distant from the Ile Terenate by that course 620. leagues, and from thence he sayled still Southwest to the Cape di Buona Speranza, which hauing in South Latitude 35. degrées, is distant from Iaua maior 1660. leagues, then from Capo di Buona Speranza he making his course northwest, sailed to an Iland called Serra Liona, which is vpon the coast of Afrique, and hauing in North Latitude 7. degrées 30 is distant from Capo di Buona Speranza 1100. leagues, then from thence hee sailed towards the Iles of Capo verde vntill he came to the 12. degrée of North latitude right vnder the first Meridian, which point is distant from the Iland Serra Liona according to that

course 320. leagues, and from thence he sayled Northwards nigh to the Iles called Azores on the West side thereof, which hauing of North latitude 40. degrees are distant by that course from the Iles of Capo verde 600 leagues, from whence hee directed his course Northeast to Plimouth, which hauing in North Latitude 51. degr. is distant by that course from the Azores 500. leagues, so as in his returne from Noua Albion to Plymouth hee sayled in all 6030. leagues, which if you adde to the number of leagues of his outward voyage before set downe, which is 5780. leagues, you shall find the totall sum of the leagues to be 11860. leagues, which is almost twice so much as the compasse of the whole world which if you measure vppon the Globe by the Equinoctiall line containing 360. degrees, and doe allow for euery degree therof 60 Italian miles, you shall find the number of such miles to amount to 21600. miles, which by allowing three miles to a league doe make no more but 7200. leagues. But if it might please Sir Frances to write a perfect Diarie of his whole voyage, shewing how much he sayled in a day, and what watering places he found, and where he touched, and how long he rested in any place, & what good Ports and Hauens he found, & what anchorage good or bad, and what maner of people, what trade of liuing, and what kind of building and gouernment they vsed, as well in ciuill as in martiall affaires. Also in what aire they liued, and whether the ground were fertile or barren, dry or wel watered with floods & fountains, what mountaines, what mines, what woods or forests, what beasts fowles, or fishes, fruites, hearbes, plants, or other commodities he found therein, and in what manner of seas hee sayled, and what winds & currents were most rife in euery place: Also what rocks, sands, sholdes, and all other places of daunger and perill, and by what marks such places are to be shunned. And finally what Moon doth make a full sea in euery Port where he arriued, & what winds doe alter any tide or Current, and all other necessarye accidents most meete for sea men to know. In thus doing the said S. Frances I say should greatly profite his countrie men, and thereby deserue immortall fame, of all which things, I doubt not but that he hath already written, and wil publish the same when he shal thinke most meete.

The

The voyage of M. Candish vnto the West and East Indies, described on the Terrestriall Globe by the blew line.



This blewe line as you see taketh his beginning from Plymouth like as the redde line doth, whereby you may plainely see, that M. Candish did not greatly differ in his course from that which Sir Frances Helde, sauing that Master Candish hauing once passed the straight Magellane Westward, sayled not so farre Northward as Sir Frances did, for hee sayled no further Northwarde but to the Port Saint Lucas, which is almost vnder the Tropique of Cancer, for that Port hath in North Latitude 22. degrees 30. keping alwayes a nigher course vnto the maine, then Sir Frances did, and from the Port S. Lucas he sayled in a maner southeast about 320. leag. and then he directed his course Eastward towards the Moluccas, & before he came to the Moluccas, he fetched about the Ile Catanaim, which is more Northward thē Sir Frances went in those parts, and from thence hee sayled full South to the Moluccas, from whence he directed his course Southwest, & passed betwixt the Iles Iaua maior and Iaua minor, which two Iles in the said great Globe are made to haue one selfe Latitude (that is to say) about 10. degr. of South Latitude, counting frō the Equinoctiall to ỳ Parallel which passeth through both the Iles. But in all other globes & Maps Iaua minor standeth 10. degr. more to the South and is placed behind ỳ south promontory called the land of Beach. Then hauing passed betwixt the foresaid 2. Iles, he held in a maner the like course ỳ S. Frances did in his returne to Plimouth, which ỳ blew line doth shew so plainly as it needeth none other descriptiō. Now as touching S. Martin Furboshers voiage, because his own description therof is in print, nothing is set downe in this globe, but only ỳ outermost end of his voiage named here Furbushers straights, hauing in North latitude about 63. degrees, in the mouth of which straights is a little Iland called Hales Iland on

the right hand, and on the left hand another little long Iland called Leceſters point. Truely this knight for his valourous venter, alwel in this voyage as in diuers other his worthy ſeruices done vpon the ſea deſerueth great commendation, and I wiſh with all my heart that he & ſuch like might bee much made of, and rewarded according to their deſert. And thus I leaue to ſpeake any further of M. Molineux his Globes, the vſe whereof is to be learned by thoſe Propoſitions which I haue heeretofore ſet downe, ſhewing the vſe of Mercator his two Globes, for the practiſe and manner of working both by his Globes and by theſe Globes is all one.

A

A plaine and full deſcription of *Petrus Plancius* his vniuerſall Map,

ſeruing both for ſea and land, and by him lately put foorth in the yeare of our Lord, 1592.

In which Mappe are ſet downe many more places, aſwell of both the Indies as of Afrique, together with their true Longitudes and Latitudes then are to be found either in *Mercator* his Mappe, or in any other moderne Map whatſoeuer, and this Map doth ſhew what riches, power or commodities, as what kindes of beaſtes both wilde and tame, what plants, fruits, or mines any Region hath, and what kinds of marchandizes do come from euery Region.

Alſo the diuers qualities and maners of the people, and to *whom they are ſubiect. Alſo who be the moſt mightie and greateſt* Princes of the world: A Mappe meete to adorne the houſe of any Gentleman or Marchant that delighteth in Geographie, and therwith this Booke is alſo meete to be bought, for that it plainly expoundeth euery thing contained in the ſaid Mappe.

Written in our mother tongue by M. *Blundeuill*

Anno Domini, 1594.



Imprinted at London by *Iohn Windet*.

IN DOCTISSIMI VERE-QVE GENEROSISSIMI VIRI, *THO. BLVNDEVILI*, IN *PETRI PLANCII* TABVLAM GEOGRAPHICAM ET HYDROGRAPHICAM ELVcidationes, *Gualteri Hawghi*

Διεκατετράστιχον.

PLancius in tabula terras descripsit & vndas,
Quæcunq; & toto condidit orbe Deus:
Multiplices horum partes, Regumq; per illas
Sceptra superba, simul totius orbis opes.
Sed solis Gallis hæc Plancius, atq; Latinis,
Inter & hos, Doctis scripserat, haud aliis,
Tu Generose tuis patrio hæc Idiomate clarè
Blundeuile refers, Cunctaq; nota facis.
Tu simul hæc auges, lucemq; his addis, & horum
Vsum, multiplici non sine fruge doces.
Nec solum doctis, sed & omnibus hæc Idiotis
Perspicua vt pateant, tu breuitate facis.
Plancius hæc aliis, tu nobis omnia tradis,
Tuque tuis Anglis Plancius alter eris.

A plaine and ful deſcription of Plancius *his vniuerſall Mappe, ſet foorth in* the yeare of our Lord, 1592. written in our mother tongue by M. *Blundeuill.*

IN this Mappe, as you ſée, are drawn with redde Inke two lines or Diameters croſſing one an other with right Angles in the very midſt of the Mappe, whereof the perpendicular Diameter paſſing through the Iles Azores, and alſo through the Iles of Capo verde, ſignifieth the firſt Meridian and Axletrée of the world, at the vpper end whereof is ſet the North pole, and at the neather end the South pole. And the other ouerthwart Diameter ſignifieth the Equinoctiall, and alſo the line of Eaſt and Weſt, that is to ſay, Eaſt on the right hand, and Weſt on the left hand. And in this line are ſet downe the degrées of Longitude, which are to bee counted from the foreſaid firſt Meridian vppon the ſaid Equinoctiall towardes your right hande from one degrée to 180. ſet downe in Arithmeticall figures thus, 10. 20. 30. and ſo forth vntill you come to 180. which is the Eaſt Longitude of the world, and the Weſt Longitude beginneth on your left hande whereas is ſet downe 190. and then 200. and ſo forth vntill you come to 360. degrées, which is the whole circuit of the Equinoctiall, and of the whole earth. And in the firſt Meridian are ſet downe the degrées of Latitude, which doe proceede from the Equinoctiall to

eyther of the Poles from one degrée to 90. written in Arithmeticall figures thus, 5. 10. 15. and so forth to 90. which degrees doe proceede with equall distances from the Equinoctiall to eyther Pole, and the like degrées of Latitude are also set downe vpon the two outermost Meridians, as well on the right hande as on the left. And on ech side of the Equinoctiall are drawne with redde inke the two Tropiques, that is to saye, the Tropique of Cancer, and the Tropique of Capricorne, ech one being distant from the Equinoctial 23. degrées 28. which is the greatest declination of the Sunne, and towards ech pole are also drawne with redde inke the two Circles both Arctique & Antarctique, whereof the circle Arctique passeth through the Northernly part of Island hauing in Latitude 66. degrées 30. and the Circle Antarctique passeth through the like degrées of Latitude towards the South pole, and the distance of each of those Circles from either pole is equall to the greatest declination of the Sunne. And these foure Circles are Parallels to the Equinoctial, bounding the 5. Zones that is, the two cold, the two temperate, & the hotte Zone which lyeth in the midst of the world betwixt the two Tropiques. And on the left hand or West part of the Mappe are set downe from the Equinoctiall vpward towards the North pole, what number of miles and secondes of miles doe belong to euery degrée of the North Latitude, proceeding from the Equinoctiall towardes the North pole: for though that euery degrée of the Equinoctiall being a great Circle containeth 60. miles, yet the further that you goe from the Equinoctiall towards either of the Poles, the lesser and lesser are your Parallel Circles in compasse, and therefore one degrée of euery such Parallel must néedes containe the fewer miles, but because the sea men doe commonly make their account on the sea by leagues, and not by miles: Plancius here right vnder the former Table of miles, setteth downe the number of leagues incident to euery degrée or Parallel, in descending from the Equinoctiall to the South pole, appointing three miles to a league, and therefore he setteth downe vppon the very Equinoctiall 20. leagues, which is 60. miles, and next to that he setteth downe 19 leagues 59. and so procéedeth forth diminishing still the quantitie of the leagues, euen till you come to the very South pole, and

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on the right hand of the Map hard by the outmost Meridian are set downe the nine Climes, and the longest day in euery degree of latitude, procéding aswell from the Equinoctiall to the North pole, as also from the Equinoctiall to the South pole, from 12. houres to 187. dayes and 7. houres, which maketh the longest day to those that dwell right vnder the North Pole to bee halfe a yeare and the night asmuch. Besides the Circles and lines before mentioned, there are set downe in this Mappe certaine flies of the Mariners Compasse, each one containing two and thirtie lines, which doe signifie the two and thirtie rombes or winds of the Mariners Compasse to knowe thereby how one place beareth from another, and by what winde the Mariner hath to sayle to any place whereunto he would goe: In euery which fly the line of North and South may serue in stead of a Meridian, and the line of East and West may serue as a Paralell, by helpe whereof you may the more readily take with your Compasses the Longitude and latitude of any place contained in the Mappe in such manner as is taught in my first Treatise of Vniuersall Mappes. Also in the very front of his Mappe hee setteth downe the numbers of foure and twentie houres, euery houre containing fifténe degrées of the equinoctiall, which houres doe beginne on the right hande, and so procéde to the left, whereof the twelfth houre is placed at the ende of that Meridian which passeth through the Fortunate Iles. Now betwixt the 72. and 86. degrées of North latitude hee setteth downe two long Ilandes extending from the West towardes the East somewhat beyond the first Meridian, and from the saide Meridian more Eastward he setteth downe other two long Ilandes, affirming that the North Ocean sea breaking in betwixt these Ilands with nineténe gates or entrances, maketh foure straites and is continually carryed vnder the North Pole, and there is swallowed vp into the bowels of the earth, and hee saith further that right vnder the North pole there is a certaine blacke and most high rocke which hath in circuite thirtie and three leagues, which is ninety and nine miles, and that the long Ilande next to the Pole on the West is the best and most healthfull of all the North parts. Next to the foresaid Ilandes more Southward

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hee setteth downe the Ilandes of Crocklande and Groynelande, making them to haue a farre longer and more slender shape then all other mappes doe: At the East ende of the thirde long Ilande, is a straite hauing fiue gates or entrances, which by reason of their narrownesse and swift course of streame are neuer frozen, if this be true, I meruayle how any shippe durst enter through any of those straites to discouer the North sides of any of those Ilandes, and how and where it came out againe. Moreouer at the East ende of the last Ilande somewhat to the Southwarde, he placeth the Pole of the Lodestone which is called in Latine *Magnes*, euen as *Mercator* doth in his Mappe who supposing the first Meridian to passe through Saint *Marie* or Saint *Michael*, which are two of the outermost Ilands of the Azores Eastwarde, placeth the Pole of the stone in the seuentie fiue degrée of Latitude, but supposing the first Meridian to passe through the Ile Coruo, which is the furthest Ile of the Azores Westwarde, he placeth the Pole of the Lodestone in the seuentie seuen degrée of Latitude. I thought good to seuer the Ilandes last before mentioned from the bodie of the Map as partes belonging rather to the North Pole, then to Europe, Asia, Africa, or America: for if Virgill did not let to say that Englande was Penitus excluſa ab orbe, mée thinkes that I may much more rightly say the like of these Ilandes, notwithstanding Plancius maketh the first two long Ilandes and also Groynelande and Crockelande to bée part of *Mexicana*, which mée thinkes is not meete, sith they bee deuided by the North Sea, likewise he maketh the land which is vnder the South Pole, and is not as yet discouered, to bee parte of *Magellanica*, which (in mine opinion) ought not to bée so, sith it is not onely deuided from *Magellanica*, by the straight *Magellanicum*, but also from Afrique and from the East Indies by the great Southerne Ocean, and I beléeue that when the Southlande shall bée all discouered, it wil containe twice so much land as *Magellanica* doth, and then I doub: not but that the Geographers will giue it some other name, and make many diuisions thereof: In the meane time I will follow Plancius his owne diuision of the world, which greatly differeth from that

of

of Mercator, and of all other moderne Geographers, for they do deuide the whole earth but into foure parts, that is to say Europe, Afrique, Asia, and America, but Plancius by deuiding America into thrée parts, ý is, into Mexicana, Peruana and Magellanica, deuideth the whole earth into fiue parts, that is to say, Europe, Asia, Afrique, and into the thrée partes of America last mentioned, according to which diuision, hee describeth the earth in the french tongue in sixténe pages, set downe at the foote of his Map, the foure last pages whereof doe onely containe the interpretation of the seuentie one little Tables or Inscriptions written in the Latine tongue, dispersed throughout the whole Mappe, expressing therein such thinges as hee thought most méete to bée noted in diuers parts of the worlde, all which Tables or inscriptions, I haue héere also set downe in our mother tongue: And although that to the foresaide Tables or Inscriptions Plancius hath attributed certaine numbers for the more easie finding out of the said inscriptions, yet not easie enough by reason that one selfe number is set downe in diuers Tables, and therefore to the intent that you might the more readily finde out euery Table that is proper to the matter whereof it maketh mention, I haue héere following ioyned to the number of euerie such Table his proper Longitude and Latitude, which with your Compasse you may quickly find out, and more certainely, then by his numbers, if you remember the order thereof set downe in my treatise of vniuersall Mappes. But now I will declare the contentes of the foresaide sixténe pages in order as followeth.

The

The title of the firſt page is thus.

A briefe declaration of the diuiſion, forme or ſhape, and of the particularities of the world.

The Contents of the firſt page.

THat the earth and the water doe make both together one round bodie, which the Coſinographers doe inuiron with fiue Circles, that is the Equinoctiall, the two Tropiques, and the two Polar Circles, and thereby doe deuide the woꝛld into fiue Zones, two cold, two temperate, and one extreame hotte: and though that the auncient Geographers doe affirme that thꝛée of thoſe Zones were vnhabitable, the one foꝛ extremitie of heat, and the other two foꝛ extremitie of cold, yet within theſe hundꝛed yeares laſt paſt it is knowne by good experience that thoſe thꝛée Zones are well inhabited as the manifold Countries therein placed and greatly replenished with people of ſundꝛy languages doe well teſtifie, of al which things I haue written at large in my Spheare. And thereforꝛe I make this page the ſhoꝛter.

The Contents of the ſecond page.

TO know the true ſituation of the Pꝛouinces and places contained in this Mappe, it is neceſſarie firſt to knowe their Longitudes and latitudes. The degrées of Latitude oꝛ of the eleuation of the Pole, which is all one thing, are counted from the Equinoctiall to eyther Pole, which is 90. degrées, and the degrées of Longitude are counted vpon the Equinoctiall from the Iles of Capo Verde towardes the Eaſt, and ſo rounde about the earth vntill you come to the number of 360. degrées. The Pꝛouinces and Townes that are ſituated

ſituated vnder one degrée of longitude, haue at one ſelfe time like houres of the day, but thoſe that are ſituate vnder diuers degrées of longitude, doe differ in number of houres, for when it is in one Towne nowtiue, it is in another Towne that is diſtant from thence towardes the Eaſt 30. degrées, two of the clocke in the afternoone, and ſo conſequently for euery 15. degrée of diſtance they differ an houre. Likewiſe they that dwell vnder one ſelfe degrée of latitude haue equall quantitie of dayes and nights, but yet ſo as they which dwell on the South ſide of the Equinoctiall haue the ſhortest day when wee haue the longeſt, and haue Winter when we haue Sommer. But thoſe that are ſituate vnder diuers degrées of latitude, haue inequalitie of dayes and nightes, for the nigher that any place is ſituate towards any of the Poles, the more houres the longeſt day of the yeare in that place contayneth. But thoſe that dwell right vnder the Equinoctiall haue alwaies their dayes and nightes of like quantitie, and I vnderſtande here by the day, the ſpace betwixt the Sunne riſe and the ſunne ſet, and you ſhall finde the quantitie of the longeſt day of the yeare in euery degrée of latitude ſet downe in the Northeaſt part of this Carde. As for example, to thoſe that haue 30. degrées of latitude, the longeſt day is 13. houres 57'. and ſo the nigher that you go to the Pole the longer is the day, in ſo much as thoſe that dwell right vnder the Pole, the yeare is but a day and a night, that is to ſay, they haue 6. moneths day, & 6. months night. Moreouer the Geographers do diuide ỹ earth into 9. clymes for to diſtinguiſh therby the prouinces & regions by the quantitie of the longeſt day, the middlemoſt parallel of euery clime increaſing by half an houre, and you haue to conſider that the degrées of latitude are in al places of like bignes euery degrée contayning 15. Almain leagues, or 60. Italian miles, but the degrées of longitude proceéding from the Equinoctial towards any of the 2. Poles are vnequal, that is to ſay, euerie one contayning fewer leagues or miles then other, but the degrées of the Equinoctiall it ſelfe are equall to the degrées of latitude, euery one containing 15. Germaine leagues or 60. Italian miles, as you may playnely ſée in the Table ſet downe in the Northweſt part of this Map. And you haue to note that on Al-

maine

main league doth containe 4. Italian miles, and we haue described the degrees of longitude in the Southwest part of this Carde by the houres of the ships way, euery one decreasing lesse then other from the Equinoctiall to the Pole; whereby you may conceyue that two shippes being right vnder the Equinoctiall 150. degrées distant one from another, and are to sayle with like gate towardes the North pole: when they shall come to the 60. degrée of latitude, their distance shall be no more but 75. leagues. And the further they go towardes the Pole the lesse distance they shal be one from another, in so much as when they bee right vnder the Pole it selfe, they shall both méete, as you may sée in the 2. round figures containing the description of the earth, and set downe in the 2. nether corners of the Map. This matter is to bée considered of the Marriners, that they may thereby the better perceyue the imperfections of their sea Cardes. Moreouer, in the second page Plancius setteth downe the diuision of the earth as well according to the ancient as moderne Geographers, making first three generall continentes or firme landes, whereof the first is so much as was knowne to Ptolomey and to the ancient Astronomers, as Europe, Afrique, and Asia, the seconde continent is called America, and the third continent is the South part of the world, not yet fully discouered, called of Plancius Magellanica, and he deuideth the second continent called America into three parts, that is, Mexicana, Peruana, and Maggellanica, and by adding those three parts to Europe, Afrique, and Asia, he diuideth the earth into fiue partes, and first hee setteth downe the description of Europe together with her bounds or limits, and then the commodities thereof, as followeth.

Of Europe.

EVrope is farre lesse than all the rest, and yet excédeth all others in noblenesse, in magnificencie, in multitude of people, in might, puissance, and renowme, the which in times past hath commanded both Asia and Afrique as Quéene, by reason of the Monarchies of the Grékes and of the Romaines, and at this day is of great force by the power of the Turks and Musco-

uites

nites. Moreouer it commandeth many prouinces in *Mexicana* and Peruana by the power of the Spaniards and Portugalles, and of other Christian Princes.

Europe is seuered from Asia & Afrique by the sea *Mediterraneum*, and by the sea called Marmagior, and by the Marish or sea called Palus Meotis, and by the Flood Tanais & Dwina. The chiefest prouinces of Europe are these, Almanie, Italie, France, Spaine, Denmarke, Norway, Swethland, Muscouia, Polonia, Hungaria, Sclauonia and Greece. The chiefest Ilands of Europe are these, England with Scotland, Ireland, Sardinia, Corsica, Sicilia, Candia, Nigro Ponte sometime called Euboia, and Stalimine, sometime called Lemnos. And in this second page he setteth downe also the description of Almanie thus.

Almanie is reputed to bee the greatest prouince in all Europe, and is situated in the middest thereof, which is bounded on the East with Polonia and Hungaria, on the South with Dalmacia, and Italia, and on the West with Fraunce, and on the North with the North Sea, and with the Sea called *Mare* Balticum. The inhabitantes of this Countrey warred in olde time with the Romaines for their libertie, and since many hundred yeares past it hath holden the imperiall Scepter. About the time of Christ his birth, it was a rude countrey, as Cornelius Tacitus saith, full of Wood, bushes, and Marishes, but at this day it is so adorned with great magnificent Townes and well fortified, and is furnished with such a number of Castles, and Villages, and with such a number of people, and with such politique gouernment, as it is to bé compared to any prouince whatsoeuer in all the worlde. The soyle thereof is very fruitfull both for Corne and Wine, and hath many nauigable Floods stored with plentie of Fish. It hath most excellent fountaines, and hotte Bathes, great Mines of Golde, of Siluer, copper, Tinne, Lead and Iron. The inhabitantes doe exercise as wel now as they haue done in times past the Arte military, and it hath many learned men very skilfull in all sciences, and in mechanicall arts, they were the inuenters of Artillerie, of Gunpowder, and of the noble art of printing, & of making artificial Dials and horologies.

The

The chiefe merchandizes that are transported out of Almanie into other countries are these, Golde, Siluer, Copper, Tinne, Leade, vitriol, Allum, Quicksiluer, Collours of diuers sortes, Slates to couer houses, Wheate, Wine, Fish, woollen cloath, Linnen cloath, Bombasine, Fustian, Suile, Armour, all sorts of workes made of Iron, or brasse, and other merceries.

The contents of the third page.

IN the thirde Page he describeth the 17. Prouinces of the lowe Countries, also Italie, France, Spaine, and Denmarke, as followeth.

THe 17. Prouinces of the low Countries are counted a part of Almanie, by reason that the most part of the inhabitantes haue as well their originall as their language from the Almaines. But those of Artoys, of Henough Namures, and part of the inhabitantes of Brabant, Flaunders, Lymburgh, and Liezenburgh doe speake the French tongue. These prouinces are situated partly within the ancient limits of Almany, that is to say, beyond the Orientall part of the floud Rhenus, & partly in Gallia Belgica, as also are the prouinces of ỹ 4. princes electors and of many other prouinces of the Empire. In these prouinces are many nauigable Floods and rich in fish, namely the Rheane, Mosella, Mosa, and the Escaut, and there is great aboundance of all sortes of Corne and Cattell méte for mans vse, there is also a number of great Townes, riche, mightie, and well peoplished, also of fortresses well fortified, fayre villages, but chiefly of braue and commodious portes and hauens, and an incredible number of shippes, and the continuall warres that they haue had and haue at this day do witnesse to all the worlde their great force, might, and riches. The inhabitants in time of the Romain Monarchie were and also are at this present greatly renowmed for their skill in the arte militarie, and besides that, they are most excellent and industrious in all sciences and mechanicall artes, and they haue a great number of Mariners

and

and Pilots well practised in the arte of Nauigation, and to these Prouinces is attributed the inuention of the Marriners Compasse, according to the opinion of many learned men, which truely is one of the noblest inuentions that euer was found out since the world beganne. In the towne of Brugheſſe was inuented the Arte of Painting with Collours tempered with Oyle.

The Prouinces of Belgia doe sende vnto other Prouinces all sortes of Cloathes made of Woll and Flaxe, linnen cloath of Cambria, Skarlettes interlaced with golde, Siluer, and Silke, Taffetas, Bozattas, Grograines, single Buffin, Saies of Leyden, and *Howscot*, Mozsteds, and halfe Mozsteds, Fustianapes of Uellures, and of Wool, Bayes, silk, parchment lace, Sarcenet and inkle, all manner of twisted thred, silke ready dyed, purified Sugar, Buffe, Shamoyes, striped Marokines, painted Pictures, Bookes, Armour, Cables, Ropes, and other Munitions belonging to Shippes, Knives, Pinnes, and all sortes of Mercerie or Haberdash ware, and Fish dried and salted.

ITaly being the mother of eloquence and of al Latine erudition doth extend it selfe like an arme towards the Southeast, lying betwixt the Tuscane sea and the gulfe of Venice, and is bounded on the west part with France & on the north part with Almanie, being seperated from the said two Prouinces by the Flood Varo and the Alpes, & all the rest is inuironed with the sea, at the time of the natiuitie of Christ and since, she most flourished, being adorned with the fourth Monarchie, and with the most mightie towne of Rome, which at that time was Quéne of many prouinces of Europe, Asia, and Afrique, which citie in the time of the Emperour Vespasian, had in circuit 13. Italian miles and 200. paces, as Plinie writeth in his third booke and fist chapter. Flauius Vopiscus reciteth that this towne was inlarged by the Emperour Aurelius to 30. Italian miles, which is 10. houres of way or gate, allowing three myles for an houre. This Prouince hath brought forth, as it doth at this present, inhabitants of great industrie and wit, and it contayneth many noble cities

and of great renowne, as Rome, which hath bene sometime the head of the world, Venice the rich, Rauenna the ancient, Naples the gentle, Florence the beautifull, Genua the proud, and Millaine the great. In a towne called Amalphe situate vpon the sea, betwixt Naples and Salerno, the Mariners Compasse was inuented in the yeare 1300. according to the opinion of some, by one Iohn Goia, citizen of the same towne: notwithstanding Iohn Gorop Becanus doth attribute that inuention to Flanders which seemeth the more likely, for so much as al the Pilats & Mariners of France and Spaine and other places do name the 32. windes or rombes of the Compasse by the Belgicke names. The chiefe merchandizes that are sent out of Italie into other countries are these, Rice, Silke, Veluet, Satten, Taffatas, fine peces of Linnen, Grograines, Rash, Stamin, Bombasins, Fustians, Feltes to make riding cloakes, plentie of rich armour, Wiar of golde and siluer, Allum, Galles, drinking glasses and looking glasses of Venice.

FRance hath bene alwayes estemed to be the chiefest realme of all Europe, whose soyle is most fertile, and bringeth forth all kind of Graine, and euery other thing that is necessary for mans sustenance, there is great store of wine, and great plentie therof is distributed to other Prouinces nigh adioyning. The Prouince doth abound in oyle Oliue, and in Corrall, and in many other noble fruites. In France are many great townes well walled, as Paris, Roan, Amiens, Orliens, Toures, Nantes, Poicters, Burghes, Tholous, Lyon, Narbona, and Marcelles. It hath 15. Archbishoprickes, and 108. Bishoprickes, and a great number of townes and villages, and 132000. parishes, it is greatly peopled, and hath not such deserts or heathes as are in other Prouinces of Europe, the French men haue bene, and are at this present renowmed in the Arte militare, and there be many learned men in all faculties and sciences.

The chiefe Merchandises that are carried out of France into other prouinces are these, Wheat, Rie, Beefes, Hogges, Swine, and other cattell, Salt, wines, wild Oliue, Chesnuts, Almonds, Prunes, Corrall, Diars wadde, Clothes, linnen, Canuas and Skinnes.

Skinnes.

SPaine is inuironed rounde about with the Sea, sauing that on one side it is seperated from Fraunce by the Mountaines Perenei. This countrey was sometime diuided into three Prouinces or Kingdomes, that is, Taraconensis, Lusitania and Betica, but now it is subdiuided into many Realmes, that is to say, Castilia, Aragon, Portugall, Gallicea, Lyon, Nauarra, Toledo, Valentia, Murcia, Granado, Cordoa, and Algarbia, the which Realms if they had béne reduced to one body of a Realme, as France is, and as they bee at this houre subiect to one onely king and Lord, it should be without doubt one of the most mighty and puissant kingdomes of Europe. The inhabitants of Spaine haue béne and are at this present much renowmed in the Arte militare, and in feates of warre, & it hath brought forth in times past many great Clearkes, as Seneca, Quintilian, Lucan and Martial, and in our time it had Iohannes Lodouicus Viues, Iohannes Osorius, and Benedictus Arias Montanus. The Prouinces of Spaine are become very rich and mightie, by reason of their nauigation into America, Africa, Arabia, Persia, India, the Iles Moluccas and China, in which Prouinces (China excepted) the king of Spaine possesseth many countries that bé rich and of great power, and many townes and fortresses in a manner round about the earth.

The chiefe Merchandizes that grow in Spaine, and are carried into other Countries are these, wines Oyles, Rice, all sortes of fruites of Spaine, Liquoras, Silke, great quantitie of Woll, Lambe skinnes, Corke, Rosin, Steele, Iron and Armour.

DEnmarke and Norway are very great Regions, and are as large as the cruntries of Almanie, bordering vpon Almanie towardes the South, they extend towardes the North to 71. degrée 30′. of North latitude, and towardes the East they border vpon Swethland, and on the West and North side they are inuironed with the Sea. These two Realmes are at this day vnder the gouernment of one onely king, who also is Lorde of Islande and of the Iles of Fero, Hitland, and Gothlande.

Iuthland was sometime the habitation of the Cimbres, who in times past made cruell warres against the Romaines.

The Merchandizes sent from the two foresaid realmes into other prouinces are these, Oxen, Barly, Malt, stockfish, tallowe, nuts and Filberds, hydes of Oxen, and Bucke skins, Masts for ships, plancks and the tops of Wainscot, Soliues, and fire wood to burne, pitch and Tar, Sulphur and such other things.

The Contents of the 4. page, wherein he describeth *Swethland*, *Polonia*, *Hungaria*, *Sclauonia*, *Greece*, *England*, & *Scotland* as followeth.

SWethland is a great and mightie realme, bordering towards the East vpon Russia, and towards the South vpon the East sea, called *Mare* Balticum, diuiding Swethland from Almany and Pomerania, and towards the west vpon Norway and Denmarke, and towards the North vpon Finmarke. Stockholme is the Metropolitane citie in this realme, wherin the king keepeth his court. From this realme is transported into other prouinces these Merchandizes, that is to say, Copper, Iron, lead costlie Furres, hydes or skinnes of Elkes, of Oxen, of Buckes, of goats, tallow, tar, barly, malt, nuts & Filberds, and such like.

The description of *Muscouia* which should follow next, is set downe in the third table or inscription, which standeth in the very front of the table, written in Latine, the interpretation whereof hereafter followeth in his place.

THe kingdome of Polonia containeth Lituania, Podolia, the lesser Russia, Volhinia, *Massouia*, Samogitia, Prussia, and in a manner all Liuonia, which two last prouinces did belong not long since to Almania. Polonia is bounded on the East with *Muscouia* and with the Tartaries Perocopsiques, and on the South with *Moldauia*, and Hungaria, and towardes the West with Almania, and towardes the North with the sea Baltique and Muscouia.

The

The chiefe merchandizes that go out of this realme into other Prouinces are these, Wheat, Rie, and other graine, Spruse or Danske Beare, yellow Amber, Ware, hony, a certaine drinke made of Hony which wee call Meade, hydes of Oxen dryed and salted, Flaxe, Hempe, Pitch, and Tarre. Ashes, Clauellees, wood Wazier, and of Cuvelier, and other such like merchandizes.

HVngarie is a very fruitfull Realme, rich and mightie, and it is bounded on the East with Moldauia, and Valachia, and on the South with Bosnia and Croatia, and on the west with Almania, and on the North with Polonia, it hath many nauigable Riuers, wherein are great store of fish, that is to say, Danubius, Dravus, Savus, and Tibistus. The chiefe townes are these Buda, Gran, Weissenburgh, Rab, Prezburgh, Agria, Colocza, and Belgrada. The inhabitantes of this countrey are warlike and hardie, and haue béne long time heretofore a most faithfull Rampire and bulwarke to all Christendome, but in the end by reason of their ciuill warres, the better part of them haue béne subdued in our time, and are made most miserable slaues to the Turke.

The Merchandizes which goe out of Hungarie into other Prouinces are these, Gold, Siluer, Copper, and diuers sorts of Collours, Salt, Wine, Wheat, Béeues, and fresh fish of the riuer salted.

SClauonie is bounded on the East with Bulgaria, and Greece, and on the South side with the Gulfe of Venice, and on the West, with the North parte of Italie, and on the North side with Almaine and *Hungarie*. This Region contayneth many particular Prouinces as Liburnia, Croatia, Bosna, and Dalmatia, the chiefe townes whereof are these, Raguza, Salona, Sabenica, and Zara. *Sclauonie* at this time is diuided into many iurisdictions, for one great parte thereof is subiect to the Turke, another part to the Emperour of Almany, and the rest situated vpon the sea coast is subiect to the Seniorie of Venice. At this day there is no tongue (the Arabie tongue excepted) that extendeth further than the Sclauonie tongue, for

as it is the Vulgar tongue of Sclauonie, so is it familiar to them of Histria, Bohemia, Morauia, Seleucia, Polonia, and to the large Prouinces of the great Duke of Muscouia, Circassia, Perihoka, Georgiana, Mengrelia, Moldauia, Valachia, Bulgaria, Russia, Seruia, Albania, and to part of Hungarie, it is also familiar in the Court of the great Turke, and among his souldiers that serue in Asia and Africque.

GReece sometime the mother of all science and erudition, is on the East, South and West side inuironed with the sea, but on the North side it is bounded with Seruia and Bulgaria, it hath in times past valiantly fought with and beaten the Monarchie of Persia for the libertie of their countrie, and finally by Alexander the great hath triumphed ouer the same, and thereby erected the third Monarchie, by meanes wherof it came to passe ỳ the Græke tongue was made common throughout Asia, Syria, and Ægypt, vntill such time as the Saracens & the great Turke did corrupt and change the same. The Emperours did rule in Greece from the time of Constantine the great vnto the yeare 1452. in which yeare Mahomet the great Turke forced the towne of Constantinople, and abolished the Empire of Greece in such sort, as euer since this magnificent & strong imperial towne of the Christians, hath bene the seate of the Emperour of Turkie, and al the countrey made slaues to the Mahometanes.

The chiefe marchandizes that come from this countrie to other Prouinces are these, Gold, Siluer, Copper, Vitriol, diuers sorts of collours, wines, Oyle, Veluets, Damaske, Grograins, Turquesques and Wood.

ENgland together with Scotland making both but one Iland is the greatest and mightiest of all Europe. And England is enuironed on all sides with the sea, sauing on the North side, which bordereth vpon Scotland. The aire according to the situation is indifferent temperate, for though it bee more Northward than Flaunders, yet it is not subiect to such hard frostes and colde winters. The soyle is verie fruitfull, bringeth foorth great plenty of Wheate and of other Corne, it hath great plenty

of

of fruit trées, and there bee many large and faire woods, sweete fountaines, floods and riuers full of fish, and a number of good hauens, also it hath many rich Mines, as of Golde, Siluer, Lead, Iron, and chiefly of fine Tinne, wherefore it may bee worthily counted amongst the most puissant & richest Ilands of the world. This Iland nourisheth also a great number of cattell meete for mans vse, and chiefly of sheepe, which yeeldeth fine and good woll, in which partly consisteth the profite and riches of the countrey, in such sort, as the golden Fleece ought to haue beene sought for in this Ilande, and not at Cholcos. The inhabitants most commonly are tall of stature, beautifull and white of visage, couragious and meete for the warre, also they are ingenious and studious in the Arte of Nauigation, in so much as in these daies they haue traffique into very farre countries, as into Greece, Natolia, Syria, Ægypt, Barbarie, Muscouia, and into many other prouinces. London being situated vpon the Thames is the Metropolitan and chiefe towne of this Realme, and the Staple of the trade of Merchandizes, and the Courte royall, but Cambridge and Oxforde are Vniuersities.

The Merchandizes sent from Englande into other prouinces are these, broade Cloathes, Carsies, Stamines, Bayes, Sayes, Saffron, Tin, Leade, Wheate, Barley, Malte, Beare, red Herringe, sea cole, and woode.

SCotland is the North parte of this Iland, and is likwise inuironed round aboute with the sea, sauing on that side with which it borderech vpon England. This Countrey is not so fruitfull as Englande, notwithstanding it is sufficiently prouided of all things that is nedfull for mans nutriment, it is watred with diuers armes of the Sea, and is indued with many mountaines full of grasse, which serueth to fede their cattell, Edenburgh is the Metropolitane citie of this realme, wherein the K. keepeth his court. The Scottishmen are good Souldiers, which can endure scarsitie and the iniuries of the aire, and are very desirous to win honour. The inhabitants of the South part thereof doe speake the English tongue: but those of the North, and those of the Iles Hebrides doe vse the Irish tongue, and those of the

Orcades do vſe the Norway tongue.

The Merchandiſes which Scotland ſendeth to other countries are theſe, courſe clothes, Karſies, Stamins, Freeſes, Wool, Barlie, Malt, Fiſh, Hydes, leaden Owre, and Smithes cole.

The contents of the fift page.



IN this page he deſcribeth Ireland, the Iles Azores, Corſica, Sardinia, Sicilia, Candia, nigro Ponte, Stalimine, all which Ilandes doe belong to Europe, and in the latter end of this page hée beginneth to deſcribe Aſia.

IReland is nigh vnto England and Scotland, and is very rich in meddow ground, and hath great plentie of cattell as well tame as wilde, and fiſh as well of the ſea, as of freſh riuers, and great quantity of foule and birdes, but it hath ſcarcitie of corne by reaſon of the great moiſtneſſe of the ayre. This Ile is frée from all venemous beaſtes, the inhabitantes are wilde people, great and ſtrong, ſwift in running, and by little and little they waxe euery day tamer then other, vnder the gouernement of the Engliſh men.

THe Iles of Azores are called of the Flemiſh Pilots & Mariners the Flemmiſh Iles, becauſe thoſe of Bruges were the firſt that diſcouered thoſe Ilands, & albeit that at this preſent the inhabitants thereof are Portugalles, there is yet a remnant of Flemmiſh families, as of the Bruines, of the Vltrickrs & others. Theſe Iles are fruitfull, and bé 9. in number, that is to ſay, the Ile of S. Mary, S. Michael, Tercera, Gracioſa, S. George, Pico, Fayal, Flores, and Coruo.

Tercera amongſt all the reſt is the ſtrongeſt, and bringeth forth Diers Wad. The Ile of S. Michael bringeth forth Sugar, and great aboundance of good Diers Wad.

Corſica.

COrsica is situate in the sea Mediterraneum, and bringeth forth most excellent wines, rough Horses, and great hunting dogges: and this Ile is gouerned by the Genueses.

SArdinia is a very fruitfull Ile, and chiefly of Wheate, which is transported from thence into Italy and into Spaine, likewise it hath very good Wine, both red and white, and very good Salt, it hath also certaine mines of siluer, but not of so profitable yelde as in times past. The inhabitants are strong, and are able to indure great labour and trauell. In great townes they speake the Spanish tongue of Aragon, but in small townes they speake the vulgar tongue of the Ile.

SIcilia hath beene alwaies famous, and is called of Diodorus the Paragon of Iles, also the Grekes and the Latines haue greatly celebrated this Ile in their writings. This Iland hath great aboundance of Wheate and of all other grayne, also of wine, Sugar, wax, Honey, Saffron, Silke, and of all things else appertaining to the vse of man. Wherfore this Ile, together with Ægypt was sometime called the Grange of the Romanes. In this Iland is the hill Ætna, which alwaies burneth, and in the sea of Sicill nigh vnto Drepano, as Plinie writeth in his 32. booke and second chapter, there groweth very faire redde Corall, in shape like to such a tree or bush as is here figured, which while it is vnder the water is greene and tender, but so soone as it commeth into the ayre, it waxeth hard like a stone, and is redde, there is found thereof also nigh vnto the sea coast of Prouince, also in Italy nigh vnto Monte Alto, and to Naples, likewise in the red sea, and in the Gulfe of Persia, and there be three sorts of Corral, that is, red, blacke, and white.

CAndia sometime called Creta, was in olde time enritched with the famous Labyrinth, and with a hundred Citties, it had also a great number of good ships and expert Pilots, this Ile together with others, as the Ile of Zante, Cephalonia, Corfue, and diuers others, be at this present gouerned by the Senate of Venice.

The

The Merchandizes transported out of Candia into other prouinces are these, noble wines as Malmsey, Muskadine, Corrants graine of Scarlet, Sugar, Christall of the mountaine, Cotton, and Buckeskins.

NIgro Ponte, sometime called Euboia, is a very fruitful Ile in Wheate, Oyle and Wine.

SFalimene sometime called Lemnos, is an Ile which hath aboundance of Wheate, and most excellent Wines. In this Ile they digge out in the moneth of August a certaine medicinable earth called of the Physitians, Terra sigillata. There be many other Iles besides these in Europe, as in the Iles of Denmarke, the Iles of Zeland in Flanders, the Ile Frumentera, Iuica Maiorica and Minorica, and a number of Iles that are in Sclauonie and Greece.

ASia is seperated from Europe by the flouds Tanais & Dwina and from Afrique by the narrow part of land, which is nigh to Ægypt, betwixt the Mediterrane sea, and the red sea. Asia far exceedeth in greatnes both Europe, Afrique, and Peruana, & also in riches, as in pearles of great price, and precious stones and spices it exceedeth all the other countries of the world.

This region hath bene alwaies renowmed by the first and second Monarchie of the world, obtained by the Syrians & the Persians, as also it is at this day by the mightie Princes of China, and of Persia, and by the puissancie of the Tartarians.

In this part of the world man was created of God, placed in Paradice, seduced by Sathan, and redeemed by our Sauiour Iesus Christ, and in this region, were done in a maner all the historyes and actes mentioned in the old Testament, and a great part of those in the newe Testament. The most celebrated prouinces of Asia are those that belong to ỹ great Duke of Muscouia, also Tartaria and China, the rich prouince of India, as Guzarette, Corasan, Sigistan, Chirmania, Parthia, Persia, Media, Assyria, Armenia, Natolia Syria, and Arabia. The principall Iles of Asia are these, Iapan, Lucoma, Mendanao, Borneo, Sumatra,

tra, Ceiland, & Cypres, for as for the Iles of Gilolo, Moluccas Banda & Celebes, they belong to that part of the worlde which is called Magellanica.

The most mightie Potentates of Asia are these, the King of China, the King of Persia, the great Turke, and the Emperour of Rusia, otherwise called the great Duke of Muscouia, according to which Seniories all Asia is diuided into fiue parts, that is to say, the Asiaticall prouinces, belonging to the greate Duke of Muscouia 1. Tartaria 2. China 3. the Indies 4. the prouinces of the King of Persia 5. and those of the great Turke 6. And as touching the Asiaticall Prouinces of the Emperour of Rusia, and of the prouinces of Tartaria, we shall make mencion therof hereafter, when we come to translate the Tables or Inscriptions writen in Latine, marked with the numbers 3. and 4.

The Contentes of the sixth page, wherein hee describeth *China*, and the plant of pepper there growing, with the shape thereof.

CHina or Sina is the thirde part of Asia, sometime called of Ptolomy, Sinarum regio, which on the East side is enuironed with the sea called of the ancient Geographers Oceanus Siricus, or the East Ocean, and on the West it is bounded with the Indies and with Brumas, & on the North with Tartaria. This countrey is for many causes estéemed to be the most ample, the richest and most mightie Realme of all the worlde, for it extendeth from the 18. degrée to the 55. degrée of North latitude, and it containeth in longitude 450. leagues of Almanie, and it is diuided into 15. great prouinces or Realmes, that is, Quincii, otherwise called Paquin, Xanton, Xiancii, Sancii, Suchuan, Honao, Nanquii, Chequiam, Foquiem, Cantam, Quancii, Suinam, or Huinam, Quiecheu, Fuquam, or Hucquam, and Quiancii. This Realme is adorned with manie nauigable Floods, and full of Fish, it is very fruitfull

full, and bringeth forth great abundance of all kind of graine and amongst the rest, of Rice, euery yeare three or foure times in a yeare. It hath goodly woodes and forrests, wherein doe keepe a number of wilde Boares, Fores, Hares, Conies, Sables, and Martins. The mountaines are full of grasse, seruing to féede infinite heards or troopes of Cattell, both great and small. There be also many mines of precious stones, of Golde, siluer, Copper, Stéele, and Iron, and a great number of pearles, but not very round, and great abundance of silke. The townes there are very great, fortified, and well peopliſhed, which is easily knowne by the greatnesse of Cantan, which is one of the least Metropolitane Cities of the Realme, and yet it containeth in circuite 12. Italian miles, and 350. Geometricall parts, which is more than foure houres iourney, not reckoning the suburbs, which are very large and full of people. The principall Metropolitane towne where the King kéepeth his court, is named Paquine, or Suntie, that is to say in their tongue, the celestiall or heauenly Citie, touching the greatnesse whereof, the Portugals and the Castilians doe write many incredible thinges, and according to the opinion of many, it is the selfe same towne which Marcus Paulus Venetus calleth Quinzay, as that which hath diuers names in diuers languages. The like may be said of a towne in Flaunders, which the French men call Lile, the Flemings Rusill, and in Latine it is called Insulæ. In these prouinces be many good Ports and Hauens vpon the Sea, and a great number of ships: by reason whereof the Inhabitants are moued to say, that amongst them, there are as many that dwell in Ships vpon the Sea, as be of them that dwell in houses vpon the land, and that their King might easilie make a bridge to passe from China to the towne of Malaccha, which is distant from them 300. Almaine leagues. But aboue al there is one thing worthie of great admiration, and that is a wall which hath in length 400. Spanish leagues, which the King of China caused to be built, to defend the countrey against the inuasion of the Tartarians, of which thing if the ancient men had had any knowledge, they would haue counted this worke amongst the seuen wonders of the world. The inhabitants are men of spirite, and giuen to labour. There was also inuented by them such a kind

of

of writing, that euery man of what nation so euer he were, being some what exercised therein might pronounce in his mother tong, euen as it were ciphered: They inuented also certain Charriots, wherein they might saple by the Winde vpon plaine grounde, as they doe in shippes vppon the sea: There are also men amongst them that are well learned in all Sciences and especially in Architecture, wherein they excell all others, they are great louers of learning, and those that doe excell others therein are promoted to the most honourable estates: they haue good municipall lawes, and will suffer no Stewes, and they forbid that any man shall marrie any woman with whome he hath liued before in adultery, and they grieuously punish all offences, and doe forbid idlenes as the mother of many euils, yea they constraine blind men to get their liuing, by turning with their hands, milles made to grinde corne, or any other things, and in their warres against the Tartarians, they get the victorie more by fine *pollicie* and stratagems, and by multitude of people, then by prowesse or feates of Armes. The Portugals doe report that the King bringeth to the fielde 300/000. footmen, & 200/000. horsmen Now as touching their religion they be Paynims and superstitious Idolaters, sauing that there are in many places some Christians, as Marcus Paulus Venetus testifieth.

The chiefest Marchandizes transported out of China into other prouinces are these, Gold, precious stones, Pearles, Muske, Rubarbe, the medicinable roote, China, Purslane, aboundance of silke, Sugar, Rice, and all sortes of graine. The plant of Pepper is sowne at the rootes of other trees, but specially at the roote of that Indian tree, which is called Faufell, and at the rote of the Date tree, to the tops whereof it climeth vp, much like as Iuie doth vpon a tree, or like to that which is called in Latin Clematis in English Perwinkle, which will winde about euery hearbe that groweth nigh it, the rot is but small, and his leaues thin like vnto Citron leaues, but somewhat lesse, and sharpe pointed, greene and biting in the taste, the graines doe grow nigh one to another, like the long grape, and are alwaies greene vntill they be through ripe and drie, there be two kinds thereof, that is, white and blacke, but the plants of both are much like vnto our white & red Vines. Pep-

per

per groweth in places nére the sea side of Malacha, and in the Iles of Sunda and Cuda, situated nigh vnto the Ile Iaua maior, but the best kind of Pepper most plentifully groweth in the prouince of Malabar, betwixt the Cape Comori and the Cape Canonar, but long Pepper is found in the realme of Bengala, and is another kind of plant, altogether vnlike to this.

The Contentes of the seuenth page, wherein he first describeth the red figge tree of India, and setteth downe the shape thereof, then he describeth the East Indies, and last of all hee sheweth the nature of the Elephant, whose shape he setteth downe in the same page.

THe Indian figge trée groweth round about Goa, the body thereof is high and great, and extending his branches in a rounde forme, which like yellow or golden fillets doe stoope downe towards the earth, & so soone as it toucheth the earth, it bringeth forth a new generation of trées which differeth nothing at all from the mother but onely in thicknesse, des Souches, & the branches of those do bring forth new trées in like manner, in so much as the mother with her offspring will in short time spread as much ground as containeth an Italian mile in circuit, the fruites are small Figges, and red as bloud, as well without as within.

India tooke his name from the Flood Indus, which bordereth towards the East vpon the Realme of China, and towardes the South vpon the great Ocean of India, and towards the West vpon the sea of Arabia, and also vpon the Flood Indus, and towards the North vpon the sea Mare Euxinum, or Mar maior and vpon Bramas.

This countrie is iudged at this day, as it hath bene long since to be the noblest and richest countrey in all the whole world, and it is diuided by the Flood Ganges into 2. parts, whereof the West part is called Indostan, or India intra Gangem, and the East part is called India extra Gangem, and it containeth many prouinces

uinces and Realmes, as Cambaiar, Delli, Decan, Bisnagar, Malabar, Narsingar, Orixa, Bengala, Sanga, Mogores, Tipura, Gouros, Aua, Pegua, Aurea, Chersonesus, Sina, Camboia, and Campaa. These prouinces are watred with a number of goodly riuers, amongst the which Indus & Ganges are the most renowmed riuers of the world. Moreouer, these prouinces do abound in al things that may grow either within the earth or vpon ỹ earth, except it be copper and lead, as Plinie affirmeth, also all manner of Plants that grow ther are very great, braue and excellent good India excédeth all other countries in precious stones and in spices, furnishing therewith almost all the worlde. It hath manye rich mines of Gold, and great store of faire pearle, also greate multitude of all manner of cattell, horses onely excepted, which are brought thither out of Persia and Arabia. It is not long since that Callicute was the chiefe towne of Marchandize in India, but at this present Goa is the chiefe: there is also great trafique vsed at Dio, at Cananor, at Cochin, at Bengala, at Pegu, at Malacha, and at Sian.

Of the Elephant.

The Elephant amongst all other foure footed beastes is the greatest saue the Dragon and the Crocodyle, he is very ingenious, in so much, as it is incredible that which the ancient men write of him, and also the moderne, which haue sought more diligently to know his nature and disposition, hee is of force incredible, and méte to drawe shippes and boats both out of the water and into the water, and to drawe artillery and ordinance, he is also méte for the war, his téth that shoote out of his mouth are Iuorie, there is great number of them found in the Indies, and in Afrique, but the greatest and fittest for warre are found in the Ile of Ceiland, nigh to Calicute.

The Contents of the eight page, in which he describeth the beast called Rinoceros, and setteth downe his shape, and hee describeth the Sinamon tree, shewing the shape of the trunke and of the leafe thereof, and also the Muske Cat with her

her ſhape, and in the latter end of the page hee deſcribeth the Realme of Perſia.

THe beaſt called Rhinoceros, is as long and as large as the Elephant, but not ſo high, for his legges are ſhorter, he is armed not like a Tortoiſe (as Plancius ſaith) for that is couered all ouer with one ſhell, whereas this beaſt is armed with manifold ſtrong, harde, and thicke ſkales, which are yellow and ſpotted with purple, hee hath a ſtrong horne or bone vpon his noſe, whereof he taketh his name, and he hath another little horne vpon his backe, and he is a great enemie by nature vnto the Elephant, he is found in the Realmes of Cambaia, and of Bengala.

The Sinamon tree.

THe Sinamon træ, is as big as the Oliue træ, the branches and grifts whereof are very right, his leaues in collour are like to thoſe of the Laurel træ, but in ſhape like to thoſe of the Citron, his Flowers are white, and the fruites thereof are blacke and round, like a hazell Nut, the Sinamon it ſelfe is no other but the barke of the ſaid træ, which groweth in the Prouince of Malabar, and in the Iles of Iaua and Mindanao, but the beſt is found in the Ile of Ceiland.

The Muske Catte.

THe Muſke Cat, is like in ſhape to a common Catte, but ſhee is greater than either Catte or Foxe, her muzzell is ſomwhat long and armed with ſharpe téeth, and with harſh haire, which haires (being angry) ſhe will ſet vp as a Swine doth his brittles, ſhe is in collour like a Wolfe, but that ſhe is ſpotted with blacke ſpottes, the nether part of her Muzzell and the haires of her beard are white, her féete are blacke, her flanckes are whitiſh, and

doe

doe waxe whiter and whiter towards her belly, and next to her genitories, shée hath a little bagge like to a bladder or purse, into the which doth fall the precious greace or humour, which they call Ciuet and Zibeth, which Ciuet is gathered out from thence with a spoone, if shée be in mans kéeping, but when shee is abroad and at her owne libertie, her bagge being full, shée will voyd that Ciuet of her selfe, and it will yéelde such a swéete sauour, as all they that sayle by that coast may smel it a far off, as I haue heard. These musk Cattes are brought from the Realmes of Pegu and Tarnassary.

The description of Persia.

AS those in Persia haue enioyed in times past the seconde Monarchie of the world, so at this present they bee still very mightie, for the King of Persia is one of the greatest Potentates in the whole world, as hee which commandeth all the great Prouinces that doe border towards the East vpon the flood Indus, and towards the South vpon the sea called Mare Caspium, and vpon the Flood Oxo, within which limittes, are comprehended all the greatest Realmes and landes, which the ancient Geographers were woont to call by these names, Assyria, Media, Susiana, Persia, Parthia, Hircania, Margiana, Bactriana, Paropanisa, Aria, Drangiana, Arachosia, Caramania, and part of Armenia maior, the which at this present are called by other names as you may sée in the Map.

The Persians are a hardie and warlike people, and thought to bee the best ryders or horsemen in all the world, they haue very hard wars with the Turks, they be of most frée and gentle nature, louers of ciuilitie, they make great account of learning and Sciences, they honour Nobilitie, wherin they greatly differ from the Turkes. Now as touching their religion, they be Mahometists, and yet in such sort, as both they and the Turkes do count ech one the other as Heretiques in that religion.

From the prouinces of Persia are transported into other parts of the world these Merchandizes, stones called Turquesses, very faire and excellent pearles, great quantitie of silke, Veluet, Damaske

maſke armour, and a great number of moſt excellent horſes.

The Contents of the 94. page.

IN this page he deſcribeth and ſetteth downe the ſhape of the pretious ſtone named Bezar, and the Dominions of the great Turke in Aſia, and the Cittie Aden in Arabia, alſo he deſcribeth the beaſt called Cameleopardalis, and ſetteth downe his ſhape, alſo hee ſetteth downe the ſhape of three of the greateſt Pyramides that are in Ægypt.

Of the ſtone Bezar.

THe ſtone Bezar or rather Pazar (for that is his right name) groweth in Perſia in manner de Boucz, named Pazan, which are of diuers collours, but moſt commonly redde.

This ſtone Bezar groweth in a concauitie in manner of a girdle about two handfull long and three inches broade, it is medicinable, and of great efficacie againſt all manner of poyſons and venoms, and many other maladies, there is to be found of them in the entrie of Malacha and alſo in Pegu, but the beſt of them are in Perſia.

Of the Dominions which the great Turke hath in Aſia.

THe great Turke doth poſſeſſe in Aſia, Natolia, ſometime called Aſia minor, and almoſt all Armenia, Meſopotamia, called at this preſent Diarbech, or Diarbekir, Syria, and a great part of Arabia, the moſt notable Merchant townes of this countrey are theſe, Trapezunda, Alepp, and a porte vpon the ſea called *T*ripoli, alſo Aman Damaſco, with his port Barutti and Mecha.

The Merchandizes that are ſent from theſe Prouinces into other countries are theſe, great quantitie of ſilke, Veluet, Damaſk

Turkie

Turkie Carpets, Cotton, and grain of Skarlet.

The Cittie Aden.

ADen is the chiefe Merchant towne of the vpper part of Arabia, which is gouerned by diuers Kings, and this towne sendeth into other Prouinces of the fayrest Pearles, the true Baulme, Frankensence, Mirrhe, and Horses.

The beast called Camelopardalis.

THis beast is called of the Arabians, Gyraffa, but the name Camelopardalis is compounded of Camel and Pardale, which is a Leoparde, hee hath a very long necke like vnto the Cammell, & is spotted with many spots, as is the Pardale or Leopard, hee is a faire beast, and of gentle nature, as the shape his head is like vnto the head of a Hart or Stag, but greater, his hornes are small topped, and couered with haire, and are about a handfull and a halfe long, hee hath eares, tongue and feete like to an Ore, his forelegs are long and tal, and his hinder legs are short, whereby he seemeth alwaies to stand right vp, his head is somewhat higher than the Cammell, and this beast is to bee found in Arabia, Æthiopia, and India.

The Pyramides.

IN Ægypt are manie Pyramides, whereof the two greatest are counted amongst the seuen woonders of the worlde, the greatest of them (as witnesseth Peter Belon) who most diligentlie viewed the same, is at the foote foure square, and euerie square containeth in length 324. paces, and in height 250. degrées or steppes, and euerie steppe hath in breadth 45. inches, which is three foote and 9. inches, but he setteth not downe what depth euerie steppe hath, which must not bee ouer deepe: for then howe can any man easilie mount vp to the toppe thereof, for hee saith it is plaine in the toppe, and so large as 50. persons may stand thereon. It is found by writing that 360/000.

men wrought 20. yeares in building this Pyramides.

The second great Pyramides is somwhat lesse and smoth on the outsides without any degrées or steppes, and the top thereof is sharpe pointed.

The Contents of the 10. page.

IN this page he describeth the Crocodyle, and setteth downe the shape thereof, secondly, he sheweth wherof the Mummie is bred. Thirdly, he describeth the Unicorne, and setteth downe his shape.

The Crocodyle.

THe Crocodyle is found in Ægypt, in the flood Nilus, and in India in the flood Ganges, and in the two Prouinces Mexicana and Peruana in many riuers. This is a foure footed beast, which hath a horrible head, sharpe téeth, a verie small tongue, and a thicke tayle, and his skinne is harde and armed with hard scales, the nether parte of his mouth is immooueable, and the vpper part mooueable, contrarie to all beasts, he doth deuoure both men and beasts, and doth kéepe more in the water than on the land, and that which is greatly to bee wondred at, he is ingendred of an Egge, as great as a Goose egge, and he groweth by little and little vntill he come to the length of 18. cubites, or as some say to 22. cubites, which maketh 33. foote.

Of Mummie.

MUmmie is made of bodies embaulmed, which they bring from Ægypt, whereas manye such embaulmed bodies were buried, about foure houres iourney beyond Cayre, whereas was sometime the great citie of Memphis, for before the natiuitie of Iesus Christ the Egyptians being Paynims did spare no cost to kéepe the bodies of their Parents from putrifaction, and therefore they are great palpable lyes, whereby fooles are perswaded, that the Mummie procéedeth of those bodies which

which doe perish in the sands that be in the deserts of Arabia, as though it were possible that those bodies coulde bee preserued in those sands without stench or putrifaction.

Of the Vnicorne.

The Unicorne, as Lewes Vartiman testifieth, who saw two of them in the towne of *Mecha*, is of the height of a young horse or colt of 30. moneths old, which is two yeares and a halfe olde, he hath the head of a Hart, & in his forehead he hath a sharpe pointed horne three cubites long, he hath a long necke, and a mane hanging down on the one side of his necke, his legges are slender, as the legges of a Goate, and his féete are clouen much like to the Goate, his hinder féete are hairy, and his haire in collour is like to a bay horse. This beast in countenance is cruell and wilde, and yet notwithstanding mixt with a certaine sweetnes or amiablenes. His horne is of a meruelous great force and vertue against Uenome & poyson. The Unicorne is found in Æthiopia, like as the Indian Asse is found in India, which hath likewise one onely horne in his forehead.

The Contents of the 11. Page, wherein he first describeth Afrique, and then certaine fruites and spices, as Nutmegs, Mace, and cloues, and setteth downe the shape of them, then he sheweth which bee the mightiest Princes in Afrique, and thirdly he describeth Mexicana, which is the first North part of America.

AFrique being the third part of the world, is sperated from Europe and Asia by the sea Mediterraneum and the red Sea, and by the land straight which is betwixt Ægypt and Palestina. The chiefe Prouinces of Afrique are these, Ægypt, Barbarie, Biledulgarid, Sarra, Æthiopia, Nubia, the large Prouinces of the Abassines, falsely called the lande of Presser Iohn, and also *Monomotopa*. The

moſt renowmed Iles belonging to Afrique are theſe, Socotora, *Madagaſcar*, S. Thomas, the Iles of Capo Verde, & the Iles of Canarie and *Madera*.

The Nutmegge tree.

THe Nutmeg træ groweth in the Ile of Bada, and differeth not much from the Peach træ, ſauing that the leaues of the Peach træ are ſhorter and rounder: The fruite is couered with a thicke bark or huſke, which when it is ripe cleaueth in ſunder, and ſheweth the Nut together with the ſhell, which is couered with Mace, the which at the firſt viewe is as red as Skarlet, and pleaſant to behold, but when the Nut waxeth drie, the Mace to ſeuer from the Nut, and loſing by litle and little their Skarlet collour, doe waxe nigh vnto the collour of an Orange.

Of the Cloue tree.

THe Cloue træ groweth in the Iles of *Moluccas*, which in greatnes and ſhape is like vnto the Lawrell træ, ſauing that the leafe thereof is ſomewhat narrower. It hath many branches, and a great number of flowers, firſt white, afterward greene, and then red, but being dried, they become black. The cloues do grow vpon the outermoſt ends of the branches, one hard by another, and whileſt the flowers are greene they excel all other flowers in ſweet odour.

The chiefeſt Princes of Africa.

THe moſt puiſſant Princes of Afrique are theſe, the Emperour of the Moores or Ethiopians, which of the Arabians and of the Mahometiſtes is called Aticlabaſsi, and of his owne ſubiects, hee is called Acegue and Neguz of the Abaſsines, that is to ſay, Emperor and King of the Abaſsines and Moores. Then the king of *Monomotapa*, the king of *Morocho*, the Kinge of Fez and Sus. The great Turke alſo poſſeſſeth many Prouinces in Afrique.

The

The chiefest Merchandizes that come from Afrique into Europe are these, Gold, Iuory, wood of Ebony, Aloes, Baulme of Egypt, Mummie, Myrrhe, Anil feathers, Sugar, Ginger, Dates and wines of Madera, and of the Ile of Canarie.

Mexicana.

MExicana which is the fourth part of the worlde, is on all sides enuironed with the sea, sauing that nigh vnto Nombre de Dios it is ioyned by a land strait to Peruana. The chiefe prouinces of Mexicana are these, the prouince of *Mexico*, otherwise called noua Hispania, terra Florida, Norum Bega, noua Francia, Estotiland, Saguenay, Chilaga, Toconteae, Marata, California, Tolm, Qui vira, Agama, and Anian. The chiefest Iles lying on the North & Northeast part of Mexicana are these, Groynland, Crockland, Island, Freezland, Bacalaos, and Cuba.

The chiefe Merchandizes that come from Mexicana into Europe are these, Gold, Siluer, Pearles, Cochenilles, to die with, Baulme, Salsaparillia, the root Mechoicana, brimstone, hydes of Oxen and Volue.

The Contentes of the 12. Page.

IN this Page hee first describeth the beast called in that tongue Aiotochli, in Spanish Armadillio. Then hee describeth the two prouinces Peruana, and Magellanica, thē he sheweth which be the most mightie Princes of the worlde, and finally the diuers qualities of the people inhabiting the world.

THe beast Armadillio is found in the Realme of Mexico, and he is no bigger then a cat, he is headed like a Swine, and hath the feet of a Herison, and a long tayle, he is armed with scales, whereof he taketh his name, he keepeth for the

most part within the ground, and as some suppose, doth liue by the earth, by reason that he is neuer séene to eat abroad out of his den, the bones of his tayle are medicinable, and doe remedy the paine and deafnes of the eares.

Though Plancius saith that this beast is armed with skales, yet my countriman William Greenway, who is a proper seruiter both by sea and land, and hath béene in the West Indies, and hath eaten of this beast, affirmeth his flesh to be white & very delicate, and that hee hath no skales, but that his skin is white and smooth like to a pig new scalded, and that sometime he will shrinke vp the skin vpon his backe into diuers plates, and specially towards his fore parts and hinder parts, in such sort, as he will make them almost to mœte, and the former plates doe hang downe vpon his shoulders like vnto two Boldrons, and his haire is white & short, growing thin here and there one, and he is eared and tailed like a rat, euen as hee is here portraide, sauing that he is throughout of one selfe collour, and without scales.

Peruana.

PEruana being the fift part of the world, is also enuironed on al sides with the sea, saue whereas the foresaid landstrait doth ioyne the same to Mexicana, & the chiefe prouinces which it containeth are these, Brasilia, Tisnada, Caribana, Carthagena, Peru, Charchas, Chili, Chica, and the land of the Patagones. The most renowmed Iles are these, Hispaniola, otherwise called S. Domingo, Boriquen, and Margarita, which is the Ile of pearls.

The Merchandizes which are transported out of Peruana into Europe are these, gold, siluer, Emeralds, Pearls, the medicinable stone called Bezoar, Baulme, Ginger, Sugar, wood of Brasill, wood of Guaicum, called Lignum vitæ, long Pepper, Pepper of Brasill, Cassia solutiva and hides of Oxen.

Magellanica.

THis is the first part of the worlde, which as yet is but little knowne, in such sort as we cannot write any thing touching the prouinces of the same, notwithstanding it is thought that the pro-

prouince of Beach is very rich, and hath abundance of Golde, the chiefe Iles of Magellanica are these, Iava maior, and Iava minor, Timor, Banda, the Molucques, Romeros, the Iles of Salomon.

From the Ile Timor doth come into Europe, the white and pale medicinable simple called Sandalum.

From the Iles Banda doth come Nutmegs and Maces.

And from the Iles Molucques Cloues.

Which bee the great Princes of the World?

THe most mightie Princes of the world are these fiue, that is, the King of China, otherwise called the great Cham 1. the K. of Persia 2. the great Turke 3. the Emperour of Æthiopia 4. the Emperor of Russia, otherwise called the great Duke of Muscouia 5. amongst which the King of China is a Pagan or Heathen: and the great Turke and the king of Persia are Mahometists: but the Emperor of Æthiopia and the great Duke of Muscouia doe make profession of the Christian religion. Now as touching the king of Spaine, his puissance should be much greater than it is, if his prouinces were not so seperated, and so farre distant one from another.

The qualities of diuers people in the World.

AS touching the qualities of peoples, though God almightie hath created all men of one selfe blood, and that all doe take their beginning from the Arke of Noah, and that all men be of one selfe qualitie and shape of body, yet they differ in greatnesse, in proportion of members, and in collour: for the Patagones doe excéde all other creatures in greatnes. Againe, the men of China haue most commonly broad faces, little eyes, flat noses, and little beards, and those that haue smallest féete, are counted amongst them to be most beautiful, those of Africa haue grosser & thicker lippes than other people, the inhabitants of Agysimba, and of Guinea, and specially of the lands that be nigh vnto Cape de bona esperanza, are blacke, from whome the Orientall Indians doe not much differ.

The

The Abaſsines or Moores of Ægypt, bee of a duſkiſh collour like to the Oliue, the Inhabitants of Barbarie, bee called white Moores, and thoſe that dwell betwixt them and the Nigrites or blacke Moores be of a yellowiſh collour, the Spaniardes haue not found either in *Mexicana*, or in Peruana any Nigrites or blackmoores, but only in certaine villages nigh vnto Carque, the other nations vnder the hotte Zone, bee of collour browne bay, lyke a cheſſenut, and the nigher that they dwell to eyther of the Poles Arctique or Antarctique, the whiter moſt commonly they be, and as touching the reſt all are like in qualities, ſhape and faſhion of body, as hath bene ſaid before, wherefore they are méere lies that are woont to be tolde of the Pigmeans, in that they ſhould bee but a foote and a halfe high, and likewiſe that which hath béene ſpoken of people, that ſhould haue their heads, their noſes, their mouthes, and their eyes in their breaſtes, or of thoſe that are headed lyke a dogge, or of thoſe that haue but one eye, and that in their forehead, or of thoſe that haue but one foote and that ſo great, as that it couereth and ſhadoweth all their body, or of thoſe that haue great eares hanging downe to the ground. All theſe are méere lyes, inuented by vaine men, to bring fooles into admiration, for monſters are as well borne in Europe, as in other partes of the world.

NOw in the foure pages following, bee ſetteth downe in the French tongue an interpretation of the Latine inſcriptions diſperſed throughout the Mappe, euerie which inſcription hath his number added, which I doe alſo heare ſet downe in the ſame order, ioyning to euery number his Longitude and Latitude, to the intent you may the more eaſilie find out the ſaid inſcriptions, of which inſcriptions there be in all 71. diuided into fiue partes, whereof the firſt parte containeth 21. inſcriptions, belonging partly to Europe, but the moſt to Aſia, the ſecond part containeth 12. inſcriptions belonging to Afrique, the thirde parte containeth 11. inſcriptions, belonging to Mexicana, the fourth part containeth 6. inſcriptions, belonging to Peruana, and the fift part containeth 21. inſcriptions, belonging to Magellanica.

The

The 21. inscriptions belonging to Europe, but most to Asia doe here follow.

The number of inscrip.	Longitude.	Latitude.	North or South.
1	5.	85 3'o.	North.

This arme of the sea doth take his course through three places, running continually towards the North pole, and is frozen three monethes of the yeare, and it containeth in breadth about 37. leagues.

2	38. o'.	86. 3'o.	North.

It is said that this Countrey is inhabited of Dwarfes called in Latine Pigmei, being in height 4. foote as those be of Groynland, which are called Serelings.

3.	81. o'.	77. o'.	North.

Mutcouia is bounded on the North side with the sea Pitzorique, called of the ancient Geographers Mare Glaciale, that is, the frozen sea, and towardes the East it boardereth vpon Tartaria, and towards the South vpon the sea called Mare Caspium and also vpon the Turkes, and Tartaries Perocopsiques, and towardes the West, it boardereth vppon Lituania, Livonia, and vpon the Realme of Swethland: as touching their Religion they obserue the faith and ceremonies of the Greeke Church, all their Bishops called in their language Vladiques, and also their Metropolitane are vnder the obedience of the Patriarch of Constantinople. The people is wise and subtill, and yet louing seruitude more than libertie or freedome, and they all confesse themselues to be the seruants and slaues of the great Duke hauing seldome or neuer peace, for either they haue warres with those of Lituania, or with those of Livonia, or with those of Swethland, or with the Tartarians, or if they haue no warres, then they lie in garrison nigh vnto the 2. floods Tanais and Dwina, to defend their bounds from the depredations and inuasions of the Tartaries, they sharply punish robbers and stealers, and yet priuie theft and murder is seldome punished with death: their siluer

The number of inscrip.	Longitude.	Latitude.	North or South.

uer money is not rounde, but hath the forme of an egge, their countrie is euery where ful of woods, and they haue great abundance of rich furres, they send into all countries of Europe very good Flaxe and hempe to make Cables and ropes, and a great number of hides, as well of Oxen as of Elkes, great balles of Waxe, much salted Fish, and Whales grease. The great Duke, called of his seruants the Emperour of Russia, is rightly accounted amongst the most mightie Monarches of the world.

4.	98. 0′.	82. 0′	North.

This arme of the sea hath 5. mouthes or entries, and by reason that it is so straight and hath so violent a course, it is neuer frozen.

5.	123 30.	58. 0′.	North.

Vnder the name of Tartarie at this day are comprehended all the prouinces that border towards the East vpon the sea of China & towards the South, are limitted with the prouinces of China, of India, with the flood Oxio, with the sea Mare Caspium & with the lake or marish called Palus Meotis, & towards the West they are bounded with the flood Boristenes, & with the limits of Muscouia: for the Tartarians haue conquered al the countries which they possesse at this present, so as Tartary comprehendeth al that countrey which the ancient men were wont to cal Sarmiasia, Asiatica, and also the Scythias, that is, intra Imaum and extra Imaum, they began first to bee renowmed in Europe, in the yeare of Christ 1212. The Tartarians are diuided into certaine commonalties, and Colonies, called of them Hordes, but for so much as they dwell in diuers prouinces, that do extend far, and be farre distant one from another, they differ also in their maners and trade of life, they be men of a square stature, hauing broade and grosse faces, their eyes hollow sunke into their heads, and looking somewhat asquint, and thicke beards, they be strong of body & hardy, they eate horses, and all other beastes, how so euer they are slaine, sauing hogges, from which they abstaine, they are able to endure hunger, thirst, watch, and all discommodities, and when they are distressed

The number of inscrip.	Longitude.	Latitude.	North or South.

distressed in their voyages with hunger and thirst, they let their horses blood, and with that blood quench their hunger and thirst, which kind of meat they cal in their language Besermannen, they call their Emperour Cham, that is to say, Prince, and therefore Cambalu is interpreted to be the seat or towne of the Prince.

6.	125 4′ o.	50. o′.	North.

This round lake in the prouince of Sancii, toke his first originall and beginning in the yeare 1557. by reason of an inundation or flood, which carried away 7. townes, besides villages and other places nigh adioyning, and a great multitude of people, whereof none were saued but onely one infant, sitting vpon a træ.

7.	124. o′.	37. o′	North.

The inhabitants of China, are of good spirite and ingenious, insomuch as they haue inuented certaine kinde of carts, wherein they may sayle vpon euen ground, hauing wind, and sayle as they doe in shippes vpon the sea.

8	171. 3′o.	80. 30′.	North.

Plancius in this inscription setteth downe the opinion of Mercator, touching the beginning of longitude, and touching the Adamant stone, otherwise called the Lodestone, in Latine Magnes.

Frances of Diep, a most skilfull Pilot, doth witnesse that the needle of the Mariners compasse, doth turne directly to the North Pole, being in the Ilands of Capo Verde, that is to say, the Ile of Sal, the Ile of Bonauista, and the Ile of Mayo, whereunto those doe agree very nigh, which do say that the needle doth the like in the Iles of Tercera, and of S. Marie, which are part of the Flemmish Iles, otherwise called the Azores: but some others do affirme, that the needle sheweth the North pole best, being in the Ile of Corvo, which is the furthest Ile westward of the said Azores, and because the Longitude of places by most liuely reasons, ought to take his beginning from the common Meridian of the world, and from the rocke or Pole of the Adamant stone, we here

following

The number of inſcrip.	Longitude.	Latitude.	North or South.

following the opinion of thoſe that are moſt ſkilfull in this matter, haue ſet downe the firſt Meridian betwixt the Iles of Capo Verde, and the Azores, and becauſe the nædle in al other places, decline th either moze oz leſſe from the Pole of the woꝛld, ther muſt nædes be another Pole in ſome one place wherunto the nædle doth incline from all coaſtes of the woꝛlde, and I haue founde by the declination of the nædle obſerued at Ratisbone, otherwiſe called Regensberg, that is the ſame place, which I haue ſet down in the Mappe, and I haue likewiſe marked in this Carde, the ſituation of the Pole of the ſtone, in reſpect of the Ile Coruo, to the intent that accoꝛding to the outermoſt places limitted by the firſt Meridian, the outermoſt boundes, betwixt which, this Pole ought to be found, might be knowne, vntill the diligent and curious conſideration of the Pilots ſhall bꝛing vs ſomething of moꝛe certaintie. Thus farre Mercator.

9.	162. 0′.	71. 0′	North.

Theſe are the plaine fieldes of Bargu, wherof the inhabitants are called Mecriti.

10 ′	154. 30.	68. 0′.	North.

The Mount Askai, in which are to bee ſéne the ſepulchers of the Kings of Tartary.

11.	171. 30.	70. 0′.	North.

Upon this Mountaine are ſet by the Tartarians two trumpetters of bꝛaſſe, foꝛ a perpetuall memoꝛie of their freedome, gotten.

12.	175. 0′.	67, 0′.	North.

The Pꝛouince Vng, which of our men is called Gogg.

13.	170. 30.	65. 20.	North.

The Realme of Tendus, which in the time of Marcus Paulus

lus

The number of inscrip.	Longitude.	Latitude.	North or South.

lus Venetus, which was in the yeare 1290. was gouerned by those Christians, which descended from the king of Vncham.

14.	165. 30.	65. 0′.	North.

The Castell of King Vncham was builded in this place, against the inuasion of the Tartarians.

15	157. 0′.	65. 30.	North.

The Prouince Mongul, which of our men is called Magogg.

16.	159. 20.	66. 0′.	North.

The desert Belgian, which is very great, all sandie and barraine.

17.	159. 0′.	61. 30.	North.

In this Country of Cergutha, is found the best sort of muske, which groweth like an impostume or bagge, nigh vnto the nauell of a certaine beast.

18.	165. 30.	58. 0′.	North.

Campion is the Metropolitane Towne of Tanguth, wheras the inhabitants are partly Christians, partly Idolaters, & partly Mahometists.

19	158. 30.	53. 0′.	North.

This wal hath in length 400. Spanish leagues, and was built betwixt the mountaines by the King of China, against the inuasions and excursions of the Tartarians.

20.	176. 0′.	40. 0′.	North.

Iapan hath three Ilands much renowmed, seperated one from another by a straite of the sea, whereof the first and greatest is deuided into 53. Prouinces or Realmes, of which Meaco is the Metropolitane citie, the second is called Xima, which hath nine Prouinces or Realmes, the third is called Xicoca which containeth but foure Prouinces or Realmes.

21.	71. 0′.	29. 0′.	North.

Medina Talnabi, is the towne wherein is to be seene the Sepulchre of Mahomet.

The

The 12. Inſcriptions belonging to Afrique.

The number of inſcrip.	Longitude.	Latitude.	North or South.
1	67. 0′.	26. 0′.	North.

Coptos is a trim Marchant Towne, whereto are brought the Marchandiſes of India, and of Arabia, in which towne are dwelling many Chriſtians.

2	58. 0′.	21. 0′.	North.

The flood Nilus, which by his inundations doth yearely water and fatte the Countrie of Egypt, & maketh it meruailous fruitfull.

3	55. 0′.	17. 0′.	North.

The flood Nubia, taketh his originall from the lake Nuba, as Ptolomie ſaith.

4.	50. 0′.	15. 0′.	North.

The flood Niger, heere taketh his courſe, running vnder the ground 50. leagues.

5	62. 0′.	5. 0′.	North.

In this place is the ample iuriſdiction of the Emperour of Æthiopia, wrongfully called of thoſe of Europe, the laude of Preſter Iohn, the Arabs and the Moores doe call him Aticlabaſſi, but his owne ſubiects do call him Acegue, and Neguz, that is as much to ſay, as Emperour and King.

6.	58. 30′.	2. 30′.	North.

The mount Amara, whereas are moſt carefully kept with continuall watch and ward of ſouldiers, the children and Grandchildren of the Emperours of Æthiopia.

7.	53. 0′.	7. 0′.	South.

It is ſaid that this countrie is inhabited of Amazones, which are women that make warre.

8.	55. 40′.	15. 30′.	South.

In

The number of inscrip.	Longitude.	Latitude.	North or South.
In this place the King of Monomotapa, hath his great and ample iurisdictions.			
9	42. 30.	15. 40.	South.
This South part of Africque, vnknowne to the auncient writers, is called by those of Persia, and of Arabia, Zanzibar.			
10.	45. 30.	1. 0.	South.
Heere is digged out of the Mines, great abundance of golde.			
11	30. 20.	20. 0.	North.
Libia, or inward Africque, is at this day called Sarra, or the deserts.			
12.	19 0.	15. 30.	North.
The people Azanagi, are of colour blacke gray, and they couer their mouthes as a member of shame, and do neuer vncouer them but when they eat.			
The 11. Inscriptions belonging to Mexicana.			
1	301. 30.	81. 0.	North.
This Ile is thought to be the best and most holesome of all the North parts.			
2	301. 0.	74. 0.	North.
The Ile of Crockland, the inhabitants whereof say that they had their originall from Swethland.			
3.	311. 0.	61. 30.	North.

In the yeare of our Lorde, 1500. one Gaspar Corterriale a Portingale, entred into these Regions, hoping to haue founde some passage on the North towardes the Iles Molucques, but arriuing at the Riuer, which by meanes of the abundance of snow there falling, is called Rio Neuado, which hath in North Latitude 62. degrées, he did leaue to sayle any further towardes the North, by reason of the great colde there, and turning to the South did fetch in all the sea coastes vntill hee came to Capo Razo, which hath in North Latitude about 48. degrées: and in the yeare 1504. the Brittans were the first that

The number of inscrip.	Longitude	Latitude	North or South.

discouered all the sea coues of new Fraunce in America, nigh vnto the Gulfe of Saint Laurence, which hath in North Latitude about 50. degrées, and in the yeare 1524. Iohn Verazzan a Florentine, did part from the Porte of Diep, the 17. of March, in the behalfe of Frances king of France, and sayled towardes the South sea coast of new France, whereas he arriued at the 34. degrée of North Latitude, and from thence sayled towards the East, viewing all the sea coastes vntil he came to Cape Britaine, which hath in North Latitude about 46. degrées.

3.	311. 0′.	61. 30′	North.

And in the yeare 1534 new France was againe visited by the Admirall Iaques Cartier, and in the yeare next following, it was conquered to the vse of the King of France, also in the yeare 1577 Martin Furbosher Englishman, arriued at the north straite which is betwixt Groinland & Estotiland, that place hauing by this Map in the North latitude 65. deg. seeking passage by the North vnto Cathay, whereas he found certain Iles, & a mine of gold, wherwith hauing loden his ships, hee returned into Englande with great hope of profit, but his successe was not answerable to his hope.

4.	275. 20.	70. 0′.	North.

This dangerous beast is called Sucaratha, which being chased of Hunters, doth take her yong ones vpon her backe to saue both her selfe and them by flight.

5.	271. 0′.	64. 30.	North.

This is a great lake or sea of fresh water, the limites whereof are vnknowne as they of Canada do say, and as they haue heard by relation of those of Saguenay.

6	293. 30.	52. 0′.	North.

Alongst this Riuer a man may sayle very commodiously, towards the countrey of Saguenay.

7	287. 0′.	47. 40.	North.

All those that dwell betwixt Terra Florida, & Terra de Laboradot be called by one cõmon name Canadois, but there bee many diuers Nations as those of Hochelada, Honqueda, & Corterea-

lia,

The number of inscrip.	Longitude	Latitude	North or South.
7.	287. 0′.	47. 40′.	North.

li.,they are all very courteous to strangers, they liue commonly by fish, & they are clothed with skins of wild beasts, as they be also that dwell further towards the North, this countrey is also called new France, because the Britains which are French men did first discouer it in the yeare of our Lord 1504. the conquest whereof was atchieued by the Admirall Iaques Cartier in the yeare of our lord 1535. to the behoofe and vse of the French king. In the mountains towards the South, do dwel many and diuers Nations, which be cruell people, liuing without any law, & do seeke by continuall warre to vexe and oppresse one another, as the people Auanares, Albardi, Callicuares, Fagiles, Apalchem, Mocose, Capaschi, Chilage, and many others, amongst which there bee some of such agilitie and swiftnesse, as they may contend with horses, who can run fastest: they eat as those of Florida, certain kind of Spiders, Ants or Pismires, Lezards, Adders & other venemous beasts. The land of Baccalaos, is so called of the fish Baccalaos, which is there taken. Terra Florida is so called of Easter day because Iohn Ponce of Lion did discouer it on Easter day, in the yeare 1512. the which day is called of the Spaniards Pasqua de Flores: this is a fertile countrey and rich in gold.

8	271. 0′.	39. 0′.	North.

Marcus Nizza testifieth that this Prouince called the seuen Cities, is a very good countrey with whom Frances Vasker doth not agree, for he saith they be places of no value, and like to Villages, and bee vnder the iurisdiction of Cenola, which at this present is called of the Spaniards Noua Granada.

9	211. 40′.	82. 0′.	North.

The North Ocean sea, entring with 19. mouthes betwixt the Iles of the North, doth make foure straits of the sea, and running floods, which continually take their course towards the North, & there are swallowed into the bowels of the earth, like to syringes of fountaines and floods.

In mine opinion this Inscription would haue bene one of the

The number of inscrip.	Longitude.	Latitude.	North or South.

first of *Mexicana*, and not one of the last, sith it is no small leape, to turne so suddenly from the middest of America to the North pole.

10.	223. 0′.	55. 40′.	North.

This countrey is desert and plaine, in which are many wilde Horses, and Oxen with high backes like Camels, and wild sheep like vnto those which Boetius writeth (in his description of Scotland) to be found in one of the Iles of the Hebrides.

11.	240 2′0.	40. 30′.	North.

New Spayne was brought by force of armes vnder the obedience of the Spanyard, in the yeare 1518. by their generall, Ferdinando Cortes, who conquered the same with great losse of his soldiours, but with greater ruine to the inhabitantes, who fought for the libertie of their Countrey: the soile is very fertill, and the Countrey is rich in gold and siluer, for in the floodes are founde great sands of gold, and in the mountaines is drawne out of the mynes great quantitie of siluer, and alongest the sea side they take to their great profite an infinite number of Oysters, wherein are found very fayre Pearles. In this Prouince there are many salt lakes, the water whereof by force of the Sunne is turned into salt: there groweth also great aboundance of Cassia fistula, and an other kind of fruite, which the inhabitantes call in their tongue *Cacao*, it is like to an Almonde, they haue it in great price, for of it they make a certaine drinke, which they loue maruellous well. The sea and floods which doe wash this Prouince, doe furnish them with great plentie of fishe, and in those flodes are many Crocodiles, whose flesh the inhabitants doe eate, and this beast will grow to be twentie foote long and aboue. This countrey is full of great mountains and high rocks, there is great diuersitie of languages, in so much as one vnderstandeth not another without an interpretor. Mexico is the Metropolitane and Royall towne, or rather the Queene of all the principall Townes in the worlde, it is situated vpon the side of a

lake

The number of inscrip.	Longitude.	Latitude.	North or South.
11	240. 20	40, 30.	South.

lake or marish, yea the verie foundation of it is a verie marish, in such sort, as you can neyther enter into it, nor come out of it, but by bridges, and it is as well peopliſhed with inhabitants & Marchants, as any renowmed Marchant towne in Europe, the towne is very great, for it containeth in circuit 3. Spanish leagues.

The 6. inscriptions belonging to Peruana.

1	333. 0′.	3. 30.	South.

This great flood Maragnon, is called of some Oreigliana, and also the flood of the Amazones, it was discouered by Vincent Iohn Pinsonio, in the yeare 1499. and was sayled in a manner from the head spring euen vnto the sea, by Francisco Oreigiano in the yeare 1542. the which voyage he performed in eight monethes, hauing sayled 1660. leagues. This riuer keepeth his water still fresh after it is entred certaine leagues into the Sea, by reason that his course is so swift and violent.

2.	330. 30	22. 0′.	South,

Peruana is the South part of America, and is diuided by the Spaniards into fiue goodly prouinces, that is to say, Castiliador, that is to say, the golden Castilia, Pompaiana, Peru, Chila, and Bresille: The Prouince Peru (before the arriuall of the Spaniards) did extend a great deale further, when as their Countrie was yet vnder the Gouernement of their naturall King, which then was called Ingas, as Giraua and others doe write. At this present it is limited on the North with the towne Quito, and towards the South with the towne of Plata, that is to say, the siluer Towne, and it was called Peruana as some write, of the flood and Port of the Sea called Peru. It is at this present deuided according to the situation of the Countrie) into three parts, that is to say, Sierras, Andes, and the flat or plaine Countrie.

The plaine Countrie is that which lieth alongest neere to the Sea coast.

The number of inscrip.	Longitude	Latitude	North or South.
2.	330 3′0	22 0′	South.

Sierras is that part which is full of mountaines. And Andes is that part of the Mountaines which tendeth towards the East. Of all the Prouinces in the world, this is the richest in golde, and in Emeraldes, the Metropolitane Towne of this Prouince, is the Citie Lyma, otherwise called the Towne of Kinges. Castillelledor tooke the name of the great abundance of gold that is there. The Prouince Popaiana tooke his name of the renowmed Towne Popaian, Chila, is a cold countrie by reason that it is so nigh vnto the south Pole. The Prouince Brasilia, tooke his name of the wood called Brasill, which groweth there in great abundance. To these Prouinces were mete to bee ioyned these other Prouinces, that is to say, Caribana, Charcas, Chica, and the land of the Patagones.

3.	329. 0′.	28. 0′.	South.

This beast is called of some Hauce, but of a certaine people of Brasil, it is called Haye, which beaste was neuer seene to eate or drinke, as some write, and therefore some thinke that shee liueth without meat or drinke, only by the aire.

4	328. 0′	35. 2′0	South.

This kinde of beast is found in the Prouince of Parias, which in his fore parts is like a Fore, and behinde he is like an Ape, sauing that he is footed like a man, and he hath the eares of an owle, and vnder her ordinarie bellie, she hath also another bellie, which openeth and shutteth, wherein she lodgeth her young ones, vntill they are able to get their own liuing, and she neuer suffereth them to goe out, but only to sucke, Gesner calleth this Beaste an Apefore, or a Fore-Ape.

5.	329. 3′0	36. 3′0	South.

This is the land of the Patagones, the inhabitants whereof are Giants nine or ten foote high, which doe paint their visages with diuers colours, made of herbes.

In

The number of inscrip.	Longitude.	Latitude.	North or South.
6	335. 0′	51, 30.	South.

In the yeare 1582. the King of Spaine commanded here to be built certaine fortresses, at the entrie or mouth of the straight, called Mare Magellanicum.

The 21. inscriptions belonging to Magellanica.

1	188. 30.	17. 20.	South.

This land is new Guinea, so called of the Nauigants and Pylots, because the sea coast and situation therof, is like to that of Guinea in Africque, and it was called by Andrew Corsali the Florentine, the land of Piccinacoli, and perhaps it is that which Ptolomie calleth the Ile Labadia, if it may bee called an Ile, for it is not yet knowne whether it bee anie part of the South firme land or no.

2	229.0	3 1260.	South.

It is not vnknowne to all those that are exercised in Geographie, that the degrees of Longitude doe diminish and decrease frō the Equinoctiall to eyther of the Poles, eyther North or South, whereby it falleth out, that the Prouinces which are next vnto the two Poles of the world, do differ greatly from the natural shape which they haue by the roundnes of the earth, and for that cause wee haue briefely drawne a description of the whole world in two round figures or circles at the end of this Mappe, to the intent that euerie man might see their naturall situation so farre as may be shewed in Plano, that is to say in flat forme.

3	231.	72.	North.

These Prouinces at this present are little knowne, yetit is said, that they are full of many kindes of wild beastes. You shall finde this inscription in the round figure on the left hand nigh to the North pole, which indeede belongeth to Mexicana, and not to Magellanica.

4	247. 0.	14. 0.	South.

These two infortunate Ilandes were so called by Magellane himselfe, because he could find in them neither men, nor any thing

The number of inscrip.	Longitude	Latitude	North or South.
4	247. 2′0.	14. 0′.	South.

else that was meete for mans sustenance.

5	283. 0′	61. 2′0	South.

These Prouinces were discouered by a Spaniard, who being seperated by tempest at sea from the fleet or armie, ran wandring here and there through this great Southerne Sea.

6	350 4′0	85 2′0	South.

In the yeare 1493. when as the desire to sayle into farre countries increased more and more amongest the Castilians and Portugales, and that with great contention who should discouer most, Pope Alexander ordayned, that the Meridian which is 100. leagues distant towardes the West, from euery one of the Ilands aswell of Capo Verde, as of those which they call Azores, should be the boundes and limits to eyther partie, for their nauigation, determining their rights in such sort, as the Castilians should haue the West part of the world to find out vnknowne countries, and the Portingales the East part, but there was such strife and contention betwixt them afterward touching the boundes of nauigation, as this ordinance of Pope *Alexander* pleased neyther partie, and therefore in the yeare 1524. it was fully determined, that the Meridian which is distant 370. leagues towardes the West from the Ile Saint Anthonio, being the most Westerne Ile of all the Iles of Capo Verde, should by the common bounde of Nauigation to both parties.

7	19. 0′.	54. 3′0.	South.

Here vnder the latitude 42. degrees, & distant 450. leagues, from the Cape de bona speranza, and also 600. leagues distant from the Cape Saint Augustine, was founde the Promontorie of the South land, as Martin Ferdinando Dencilo hath noted in the Epitome or summe of his Geographie.

8	22. 0′.	65. 0′.	South.

In this our Geographie, wee haue in such manner described the circuite of the whole earth, as all the Countries are situa-

te.

The number of inscrip.	Longitude.	Latitude	North, or South.
8	22. 0′	65. 0′	South.

ted vnder their proper Meridians, which coulde not haue beene done, without extending them more or lesse frō the west towards the East, notwithstanding beeing desirous to satisfie those that are practised in the Arte of Nauigation, wee haue described the North Prouinces of Europe in this our Geographie, in such sorte as their situation wholly agreeth with the particular Mariners Cards.

9	57 20	54 0′	South.

The 9. Inscription intituled to the louers of Geographie.

Wee haue in this inscription of the whole earth, employed all diligence to describe all the Seas and Prouinces, in such sort as euerie place may haue his true Longitude and Latitude, in which matter, we haue spared neither labour nor cost, for wee haue diligently conferred togeather the Sea Cards, as well of the Castilians as Portingales, which they vse in their Nauigations to America, and to India, & amongest others wee obtained from Portingale a Mariners Carde, describing the whole earth very correctly, and besides that fourteene other particular Cardes, in the which likewise all the Seas and Prouinces of the whole world, with their situation were compriled, all which Cards being compared together, wee doe heere nowe set forth this newe description of all the Prouinces and Seas in the whole worlde, and that as correctly as may bee, according to the consideration and obseruation which hath bin vsed by the most expert Geographers and Pylots, euen vnto this present houre: for in this Card we doe describe all the sea coastes, Promontories, windinges in and out, Iles, Portes, deapthes, sands, showlds and rockes, also we haue added thereunto in place conuenient, the Mariners compasse, and the lines of the windes, which wee haue set downe as correctly as was possible for vs to doe, for the commoditie of Nauigation: and for so much as the true Longitude of the places can not well be obserued, without extending or enlarging too far those Prouinces that are nigh vnto the North or South Pole of the world, we haue therefore briefely comprehended the same in this

The number of inscrip.	Longitude.	Latitude.	North or South.
9	57 2'0	54 0'	South.

this our description of the world, in two rundles or circles, vnto the which wee haue added another little Geographicall Carde, comprehending the north Prouinces of Europe, to the intent that in them euerie man may see with his eyes, the naturall situation of those Prouinces as wel as it may be done in plano, as is more amplie declared in other inscriptions of this Map. And this little Septentrionall Map last mentioned, is placed at the foote of this Mappe, in the verie middest thereof comprehending all the north parts that lie betwixt the 52. degree, and 72. of Latitude.

10	79. 3'0	56. 0'.	South.

Here is a very strong current of the Sea, which runneth East, and West betwixt Madagascar and the Ile Romeros, in such sort as Nauigation there is verie troublesome and laborious, as Marcus Paulus Venetus testifieth in his third booke & 40. chap. whereof it must nedes follow of necessitie, that the sea coastes of this countrie are not farre distant from Madagascar, in such sorte as the great Orientall sea doth ebbe and flow through this straite with great violence into the West Ocean sea, whereunto agreeth the letter millive of a Candiot, who was Embassador for the Venetians to the King of Portingale. In which letter he writeth that the men of this Countrie goe al naked.

11	91. 0'.	35. 0'.	South.

To this place arriueth a Portingale ship called saint Paul.

12	212.	36.	South.

The South firme land, is called of some Magellanica, of Ferdinando Magellanus, who first discouered the same.

This inscription, together with the foure next following, are to be found in the rondle on the right hand.

13	146.	46.	South.

Marcus Paulus Venetus, and Loues Vartoman doe testifie in their bookes of peregrination, that here be verie great and ample deserts.

Be-

The number of inscrip.	Longitude.	Latitude	North or South.
14	75	52	South.

Betwixt the Ile of Saint Laurence and the Iles Romeros, doe fall a most violent flure and reflure of the Sea, East and West.

15	46	55	South.

This is the land of Popeniapes, so called of the Portingales, because those birdes in that countrie are of incredible bignes.

16	15	46	South.

This Promontorie of the South land is situate 450. Spanish Leagues from the Cape de bona speranza, and 600. Leagues from the Cape of Saint Augustine.

17	148. 0′	34. 0′.	South.

As we haue in the first rondle on the left hande set downe the description of that part of the world, which extendeth from the Equinoctiall to the North pole: so in this other rondle, wee haue set downe a description of that part of the world which extendeth from the Equinoctiall to the South pole, in such sorte as this rondle containeth all Magellanica, and almost all Peruana together with a great part of Africque, & a great number of the most noble and renowmed Iles of the world, & herein you may plainelie see with your eye, the naturall situation of those Prouinces that are nigh vnto the South pole.

18	148. 3′0.	20. 3′0.	South.

The Realme of Maletur, which abounded in all manner of spices.

19	148. 0.	15. 40.	South.

The countrie of Breach is rich in gold, but little frequented by Marchants of other Countries, by reason of the crueltie of the people.

20	161. 0′.	20. 0.	South.

Iaua Minor, bringeth forth diuerse spices which haue not yet beene seene in Europe, as Marcus Paulus Venetus testifieth in his third booke, 9 chapter.

21	170. 4′0.	3. 0′.	North.

The

The Iles Moluccas are much renoumed for the great abundance of spices, which are sent from thence into all Countries of the world: The chiefest of those Iles are these, Ternarie, Tidoris, Motir, Machian, and Bachian, vnto which some do adde Gilolo, Celebes, Burro, Amboino, and Bandar.

Besides al these inscriptions Plancius at the 4. corners of his Map setteth down 4 rundles, two aboue, & other two beneath: & in that aboue on the left hand, representing the Northern half of the celestiall Globe, hee describeth all the North stars that are alreadie, and in the other rundle on the right hand representing the Southerne halfe of the celestiall Globe, hee doth not onely set down such Southerne stars as were knowne to the auncient Astronomers, but also such Southerne starres, as haue béne founde out of latter dayes by those that haue trauailed into the East and West Indies, as the Crosse, the Southerne Triangle, Noes Doue or Pigeon, and an other in the shape of a man, called Polophilax, and certaine others, touching which starres hee setteth down nigh vnto the foresaid rundle, a certaine inscription written in the Latine tongue, which I haue heere interpreted worde for word in our mother tongue as followeth.

We haue here set downe the fixed starres in their true places answerable to the yeare 1592. and not 95. as the Printer hath made it.

Of the South Pole and of the starres that are about the same

LEast the south part of this Hemisphere or halfe Globe, should remaine void and emptie, I haue taken these Southerne starres out of the obseruation of Andreas Corsalius Florentine, and haue diligently compared the same with the writings of Americus Vesputius, and of Petrus Medina, & haue reduced ỹ saide stars into this forme or shape. But for so much as I haue séene nothing as yet to my satisfaction or contentment touching

ching the Longitude, Latitude, Magnitude or nature of the said stars, I hartely pray all those that haue any more certaine knowledge of this matter then we, that they wil enforme vs thereof to the common good of all men: As touching the pole Antarctique, Corsalius writeth that there be two cloudie stars of a meane bignesse, which with a circular motion doe goe about another starre, that is distant from the Pole almost 11. degrées, and are sometime aboue and sometime beneath the said starre. Hitherto Plancius. But now to the intent that you may the better vnderstande all the foresaide foure rondles, I thinke it not amisse to describe the same vnto you, and to shew the vse thereof as followeth. You haue to note then, that the two vpper rondles: that which is on the left hand, signifieth the Northerne halfe of the celestiall Globe, and the other rondle on the right hand, signifieth the Southerne halfe of the said Globe as hath béne saide before, and each one of these rondles is traced with certaine circles and lines: The outtermost Circle whereof being deuided into 360. degrées, and containing the Characters of the 12. signes, signifieth the Zodiaque, or rather the very Ecliptique it selfe, the Centre of which Circle, is the pole of the Zodiaque, which by continuall turning about describeth another lesser Circle harde by it, signifying in the North rondle the circle Arctique, & in the South rondle the circle Antarctique, the Center of which lesser circle in eyther rondle is the pole of the worlde, both which poles are distant from the pole of the Zodiaque 23. degrées 28, which is the greatest declination of the Sunne. Moreouer in eyther rondle are drawne vpon ech Pole of the worlde, two other circles, the largest whereof signifieth in both rondles the Equinoctiall, and the lesser thereof in the North rondle, signifieth the Tropique of Cancer, and in the South rondle the Tropique of Capricorne: besides these circles ech rondle is traced with 12. right lines, signifying those fiue Meridians or lines which passing through both the poles of the Zodiaque, doe deuide the Zodiaque into 12. equall partes, euery part containing 30. degrées: for so many degrées do belong to the Longitude of euery one of the 12. signes, whereby the Zodiaque hath in Longitude 360. degrées, which Longitude is to be counted from the first point of Aries and so forth, according to the

succession

succession of the signes, and by helpe of these lines, you may know vnder what signe any fixed starre is: I shal not nede here to shew you how the said fixed starres are situated in eyther of the rondles, nor how they are named, because their images or shapes together with their names are apparant for your eye. But if you woulde know the true place, the Longitude, Latitude, Magnitude & the nature of any fixed starre herein contained, then doe thus: First to know the place and Longitude of any starre, lay a ruler or extend a thred, so as it may passe through the Pole of the Zodiaque, and also through the body of the star, whose place and Longitude you seeke, euen to the very Zodiaque, and somwhat beyond, and thereby you shall know in what signe, and in what degree thereof that starre is, for that is his place, and you shall know his Longitude by counting from the first point of Aries, vnto that degree, for that is his Longitude.

Now to know the Latitude of any star, you haue to note that in each rondle there is a certain right blacke line extending from the Zodiaque to the Pole, deuided by vnequall spaces into 90. degrees, which line is called the skale of the fixed starres Latitude, the vse whereof is thus: Set the firme foote of your Compasses in the very pole, and extend the other foote into the middest of the bodie of that starre whose Latitude you seeke, and turne that foote standing at that widenes to the scale, and the number of degrees written vpon the skale, if you count from the Zodiaque vpward towards the Pole, will shew you the Latitude of that starre. Againe, to knowe the magnitude of any starre, Plancius setteth down in the North rondle the selfe same meane which Mercator also vseth in his celestiall Globe, that is to say, by making certain shapes of starres representing the bignesse of euery starre, according to his greatnesse, that by marking & comparing those shapes together, you might find out, or rather coniecture the greatnesse of the starre which you seeke. Lastly he sheweth the nature of any starre by setting downe nigh vnto the star, the characters of those Planets, of whose nature that starre doth participate, all which thinges you shall more plainely vnderstande by this example here following.

Suppose that you would know the place, longitude, latitude,

magnitude

magnitude and nature of the starre called Arcturus: here because this is a Northstarre, you must therfore resort to the Northrondle, and there seeke out the image Bootes, betwixt whose legs is the star called Arcturus which you seeke. And by extending a thred which may passe through the pole, and also through the body of that starre euen to the Zodiaque, and somewhat beyond, you shal find his place to bee in the 19. degree of the signe Libra, and his Longitude counting frō the first point of Aries, vnto that degrés to be 199 degrées, and by obseruing the rule before giuen, touching the knowing of the Latitude of any starre, you shall with your Compasse finde the Latitude of this starre to be almost 32. degrées Northwarde, and by his shape you shall knowe that he is of the first magnitude, and the characters of the two Planets Mars and Iupiter, placed hard by him, do shew that he is of their nature, that is to say, by participating of Mars he is extreamely hotte and dry, and by participating of Iupiter he is hotte & moist. and loke what order is to be obserued in the Northrondle, touching the Northstars, the same is likewise to bee vsed in the Southrondle containing the Southerne starres: Amongst which you may see the Images called the Crosse, whereby most Pilots in these dayes doe chiefly direct their course, being once past the Equinoctiall towardes the South pole, which Crosse, though Plancius doth here make to consist of fiue starres, yet I am sure that Martin Cortes and Peter Medina, and all other late wryters do appoint thereunto but foure starres, the shape and vse whereof I haue set downe in my Treatise of Nauigation, according to the direction of Peter Medina. And those that haue trauelled into the Indies, doe all affirme that to the Crosse there doe belong onely foure starres and no more, wherefore I maruayle much, that Plancius doth set downe fiue, whereunto perhaps hee is induced by the relation of some Spanyarde that did mistake them. Thus hauing described vnto you the two vpper rondles, representing together the celestiall Globe, and also shewed the vse thereof, I will nowe describe the two neather rondles, whereof that on the left hande representeth the Northalfe of the Terrestriall Globe, & that on the right hand the other halfe of the same Globe, towardes the South.

Pott

You haue then to vnderstande that the Centre or middle pointe in ech rondle, signifieth the Pole of the worlde, that is to say, the North pole in the North rondle, and the South pole in the South rondle, and vpon ech pole are drawne certaine Circles, the outtermost whereof, and furthest distant from the Pole signifieth the Equinoctiall, which is deuided into 360. degrées, euery degrée contayning 60. miles, which is the whole Longitude of the earth, from which circle at the end of euery tenth degree, are drawn certain right lines to the number of 18. which doe mete in the very Pole, and doe signifie halfe Meridians, whereof that which passeth through the Iles Azores, and also the Iles of Capo Verde, is the first Meridian, from whence the longitude of the earth taketh his beginning, and there also endeth: which Meridian in the rondle on the left hand, is deuided into 90. parts, procæding from the Equinoctial to the Pole, signifying the North Latitude of the worlde, the like diuision and number of degrées of Latitude, hath also the first Meridian, in the rondle on the right hande, sauing that the saide Meridian tendeth vpwarde. Moreouer you haue to vnderstande, that in each of these rondles are drawne nine Circles, equally distant one from another, called Parallels, which together with the Equinoctiall, doe make nine spaces, euery space contayning 10. degrées, & besides these circles, there are drawne in ech rondle two other circles, the one greater, & the other lesser, the greater in the rondle on the left hande being distant from the Equinoctiall 23. degrées 30. which is the greatest declination of the sunne, is called the Tropique of Cancer, and the lesser Circle being of like distance from the pole, is called the Circle Arctique, but the greater circle being of like distance from the Equinoctiall, in the rondle on the right hand, is called the tropique of Capricorne, and the lesser circle in the saide rondle inuironing the Pole, is called the Circle Antarctique vpon which circles in each rondle you shall finde their names written. The chiefest vses of these two rondles are these: first to finde out the Longitude of any place: secondly the Latitude, and thirdly the distance betwixt any two places.

To finde out the longitude of any place, you must doe thus: Extende a threde, so as it may passe through the Pole, and also through

through the place whose longitude you seeke, euen to the very Equinoctiall, and somwhat beyond, and holding the threed straight, the numbers of the degrees written vppon the Equinoctiall will shew the longitude of the place.

And if you will know the latitude of that place, or of any other doe thus, Set the one foote of your Compasse in the very pole, extending the other to the place whose Latitude you seeke, and keeping your compasse at that wideneſſe, bring the moueable foote to the first Meridian, whereon the degrees of latitude are marked, and there staying it, the number of the degrees, counting from the Equinoctiall vpward towardes the Pole, will shew the Latitude of the place. As for example, suppose that you would knowe the longitude and latitude of Lisbone, which is a famous towne in Portingale, here hauing first found out that towne in Spaine, which is nigh vnto the West Ocean, extende your threede from the pole through the middeſt of that Towne to the Equinoctiall and somewhat beyond, and you shall finde that the threede will cut the Equinoctiall in the 13 degree, which is the Longitude of Lisbone. Nowe if you would knowe the Latitude of the same place, set the one foote of your Compasse in the Pole, and extende the other foote to Lisbone, and keeping your Compasse at that wideneſſe, bring the moueable foote to the skale of Latitude, and so you shall find that Lisbone hath in North latitude 38. degrees and 3'0. Now to knowe the distance betwixt any two places doe thus, Set the one foote of your compasse in the one place, and the other foot in the other place, and apply that wideneſſe to the Equinoctiall, and looke howe many degrees of the Equinoctiall that widneſſe comprehendeth, and by allowing 60. Italian miles to euery degree, you shal haue the distance by a right line, betwixt those two places, for by doing thus, you shall finde the distance betwixt Lisbone & Compostella to be 120. miles. Thus I haue sufficiently (I hope) expounded euery thing contayned in Plancius his Map, his general skale made for the same onely excepted whereof I come now to speake. In this skale are set downe the miles of Russia, of Italy, of England, of Scotland, the French leagues, the lower leagues for Marriners, the Spanish leagues, the Germaine and Garscoine miles, which two are all one, the

miles of Sweuia in Germany, of Scandia & of Swethland which last thræ are likewise all one, the vse of which skale is thus. Take with your cõpasse the distance betwixt any 2. places which you desire to know, and apply the same to the skale of such miles as you wold know, & so many miles the 2. places shal be distance one from another as the number of the skale doth shew: but if the distant betwixt the 2. places be longer then ỳ skale, then hauing first taken the whole length of the skale with your compasses, look how many times that widenes of your compasse measuring by a right line is contained in the distance betwixt the two places, and if there bee any odde space left, streigh then your compasse to that od space, & apply that to the beginning of the skale, and adde the number of miles which you there find to the first great number, so shall you haue the totall summe. And lo here for each an example: first suppose that you would know the distance betwixt Cape S. Marie, & Cape finis terræ, which are two Capes or headlands in the West side of Spaine, both hauing in a maner one selfe Longitude, & do differ only in latitude by 6. degrées, for the one hath 37. & the other 43. in latitude, which distance if you take with your cõpasse by setting the one foot in ỳ one place, & the other foote in the other place, and applying that widenes to the skale of Italian miles, you shal find the distance to be 390. Italian miles, but if you measure the same distance accordinge to the Geographical maner, which is to allow for euery degrée of latitude 60. miles, you shal find ỳ distãce to be no more but 360. Italian miles. Let your other example be thus: Suppose that you would know the distance betwixte Compostella in Spaine and Constantinople, which haue all one Latitude and doe differ onely in Longitude, heere because the distance betwixt these two places is longer then the skale, you must take with your compasses the whole length of the skale, and then to looke how many times that widenes is cõprehended (measuring by a right line) betwixt the two said places, & you shall find that widenes to bee cõprehended in the distance betwixt those two places thræ times, wherefore if you multiply 840. by 3. it will make in all 2520. Italian miles. But if (according to the Geographicall kind of measuring) you doe multiply the difference of their Longitudes, which is 43. degrées, by the number of miles,

which

which is also 43. belonging to the Latitude of both places, which Latitude is also very nigh 43. degrees, you shall find that the distance betwixt those two townes is no more but 1870. Italian miles, which number of miles is not so great as that of the skale by 650. Italian miles. And therefore I can not thinke but that there is some error in the skale committed either by the Printer or else by the author through some negligence, and not for lacke of skill or knowledge how to make a true skale, being so excellent a Geographer as the Author by this and other his Maps heretofore made sheweth himselfe to be, or else ther is some greater mistery therin, then I perhaps do understand, for in seeking to know the distance betwixt two places differing onely in Latitude, I find the skale most times to agree with the Geographical kind of measuring, but if the two places do differ either in longitude onely, or else both in longitude and also in latitude, then I find the skale to differ very much from the Geographicall kinde of measuring, wherefore I thinke it good briefly here to set downe certaine ready waies of finding out the distance of two places, differing eyther in latitude onely, in longitude ouely, or in both, which I doe shew also at large in the second part of my Spheare, Chap. 14.

How to finde out the distance of two places differing only in Latitude.

IF the two places haue both either north or South latitude, then subtract ỳ lesser latitude out of the greater, so shal you haue the difference, which difference if you multiply by sixtie, the product shall be the number of miles, and if to the whole degrees of difference there be annexed any minutes, then you must adde to the product for euerye minute one mile. But if one of the two places haue North Latitude, and the other South Latitude, then you shall finde their difference by addition, and not by subtraction. As for example, suppose that you would know the distance betwixt a towne called

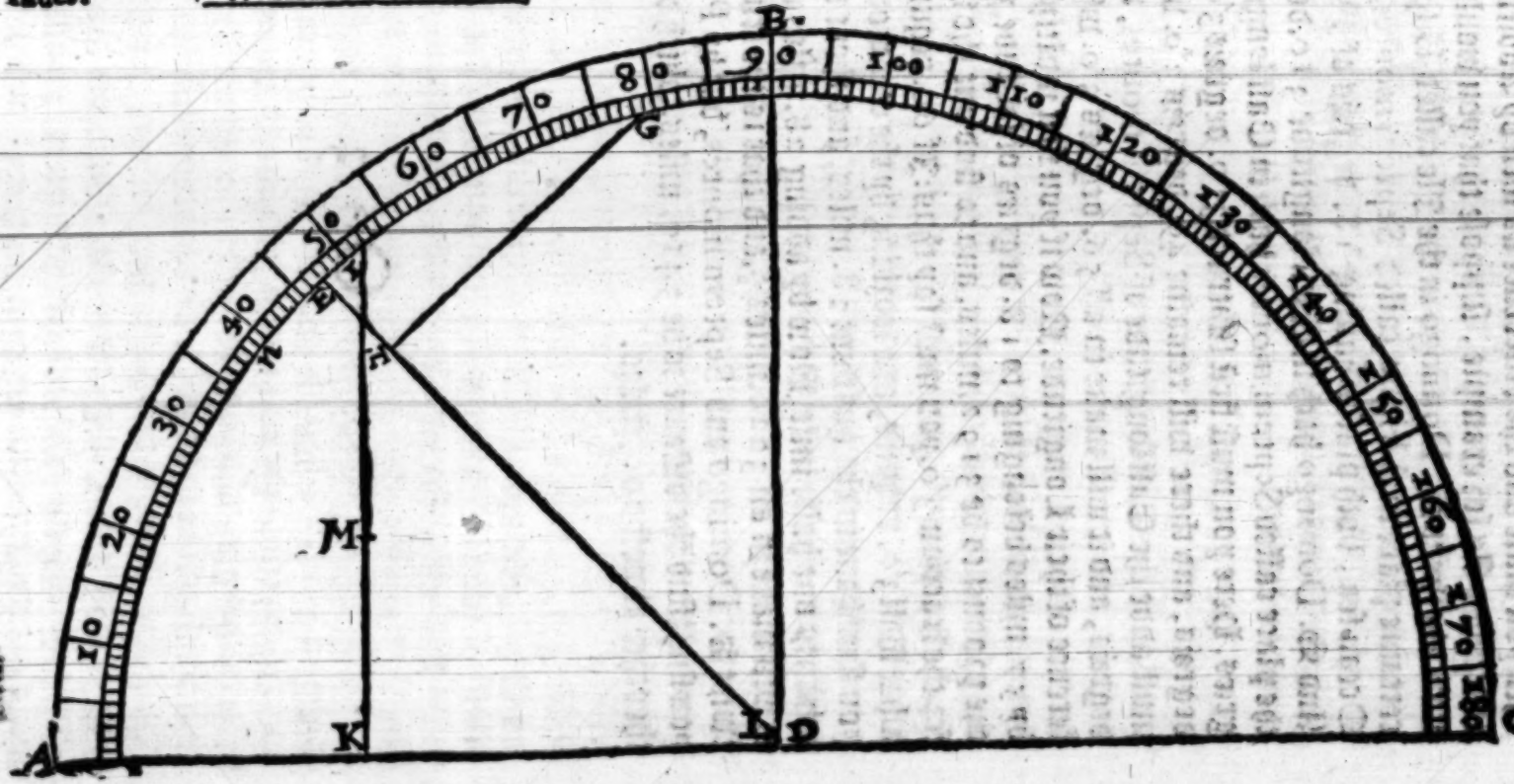
Pasquali, which is the outermost towne in Morea vpon the sea towards the South, hauing in North Latitude 35. degrées 30. and a certaine towne in Afrique called Debian standing nigh vnto the lake Zembre, which hath in South Latitude 12. degrées 30. here by adding these two latitudes together, you shall find the summe to be 48. degr. that is the difference of their Latitudes, which difference if you multiply by 60. the product wil be 2880. and that is their distance.

How to find out the distance of two places differing onely in Longitude.

IF both places haue either East Longitude or West Longitude, then subtract the lesser out of the greater, so shall you haue the difference, which difference you must multiply by the number of miles belonging to their Latitude, which you shall finde on the Northwest side of the Mappe, or by the Table of miles answerable to one degrée of euery Latitude set downe hereafter in the ende of this Treatise: and the product thereof shall bee the number of miles whereby the one place is distant from the other. As for example, I finde Compostella in Spaine and Constantinople, hauing both almost 43. degrées of North Latitude, to differ onely in East Longitude, for Compostella hath in East Longitude 13. degrées 30. and Constantinople hath in East Longitude 56. degrées, the difference whereof by subtracting the lesser out of the greater you shal finde to be 42. degrées 30. here if you multiply 42. by 43. miles belonging to one degrée of the foresaid Latitude 43. you shall find the product to bee 1806. then to finde out the value of miles for the fraction 30. by the rule of proportion, you must say thus: if 60. require 43. miles what shall 30. require, and you shall finde in the quotient 21. miles, which you must adde to the former Summe 1806. and it will make in all 1827. miles and ½. which is the true distance betwixt the two foresaide places. But if the one place haue East Longitude, and the other West Longitude, then

then you must find the difference as well by Addition as by Subtraction; As for example, suppose that you would know the distance betwixt S. Domingo in the Ile called Hispaniola, and a certaine place in Afrique called Septem montes, nigh vnto the Ocean sea, both places hauing 18. degrées of North Latitude. And S. Domingo hath in West longitude 310. degrées 30. and the place called Septem montes hath in East longitude seuen degrées. Here you must first subtract 310. degrées 30. out of 360. degrées, and there will remaine 49. degrées 30. whereunto you must adde the East longitude of Septem montes, which is seuen degrées, and it will make in all 56. degrées 30. which is the difference of their Longitude. Now if you first multiply 56. degrées by 57. miles belonging to 18. degrées of latitude, you shall finde the product to be 3192. miles, and to find out the value of miles for the fraction 30. you must say thus: If 60. require 57. miles, what shall 30. require, and working by the common rule of three, you shall haue in the quotient 28. miles, and there remaineth $\frac{30}{60}$. which is one halfe mile. Now by adding 28. miles and $\frac{1}{2}$. to 3192. it will make in all 3220. miles $\frac{1}{2}$. and that is the true distance betwixt S. Domingo and Septem montes, but by Plancius Skale you shall find the distance to be 3410. miles, which differeth from the other almost 200. miles.

	Longitude	Latitude	
London.	degrees.	degrees.	
Hierusalem.	22. 0′.	51 3′2.	The greater Lat.
The difference of their Longitudes.	69. 0.	32. 0.	The lesser Lat.
	47. 0.		



The description and vſe

How to finde out the distance of twō places differing both in Longitude and Latitude by helpe of a semi-circle deuided into 180. degrees, which I had from my louing friend *Maister* Wright of Caius Colledge in Cambridge, of whome I make mention as well in my treatise of the Spheare as in that of Nauigation.

FIrst draw a Semicircle vpon a right Diameter, marked with the letters A.B.C. D. whereof let D. be the Centre like vnto this here described, and the greater that such semicircle is, the spaces of the degrées shall be the larger, and thereby the more easie to find out the minutes. Then hauing drawne your semicircle and deuided the same accordingly, suppose that by helpe therof you would find out the distance betwixt London and Hierusalem, which two townes doe differ both in Longitude and also in Latitude so much as is here set downe in the front of the figure according to such Longitude and Latitude as Plancius doth allow to eyther towne in his great Map. Now to find out the true distance of these two townes you must first take the lesser longitude out of the greater, so shall you haue the difference of their Longitudes, which is 47. degrées, thē count that difference vpon the Semicircle beginning at A. and so procéede to B. and at the ende of that difference, make a pricke marked with the letter E. vnto which pricke draw a right line by your ruler from *D.* the Centre of the Demicircle: That done séeke out the lesser Latitude which is 32. degrées o'. in the foresaid Demicircle, beginning to account the same frō the pricke E. and so procéede towards the letter B. and at the end of the saide lesser latitude set down another pricke marked with the letter G. from which pricke or point drawe a perpendicular line, which by helpe of your squire or compasses, may fall with right Angles vpon the former right line drawne from D. to E. and wher it falleth, there set down a prick marked with the letter H. That done séeke out the greater Latitude which is 51. degrées and 32. in the fore-

said Demicircle, beginning to account the same from A. towards B. and at the end of that Latitude set downe another pricke, marked with the letter I. from whence drawe another perpendicular line that may fall by helpe of your squire or compasses, with right Angles vpon the Diameter A. C. and there make a pricke marked with the letter K. That done take with your compasse the distance that is betwixt K. and *H.* which distance you must set down vpon the said Diameter A. C. setting the one foote of your Compasse vpon K. and the other towards the Centre D. & there make a pricke marked with the letter L. then take with your Compasse the length of the shorter perpendicular line G. H. and apply that wideneſſe vppon the longer perpendicular line I. K. setting the one foote of your compasse at I. which is the end of the greater Latitude, and extend the other foote towardes K. and there make a pricke marked with the letter *M.* That done take the distance betwixt L. and M. with your Compasse and apply the same to the Demicircle setting the one foote of your compasse in A. and the other towards B. and ther make a pricke marked with the letter N And the number of degrées contained betwixt A. and N. wil shew the true distance of the two places which you shall find to bee 39. degrées, which being multiplyed by 60. maketh in al 2340. miles, and whensoeuer you haue any minutes besides the whole degrées, remember to ad vnto the summe of degrées for euery minute one mile. By Plancius skale you shall find the distance betwixt London and Hierusalem to be 3040. miles which are 700. miles too many. But you haue to note by the way, that if the difference of the Longitudes doth exceede the number of 180. then you must subtract that exceeding difference out of 360. and the remainder shall bee the difference of the Longitudes, and then worke in all points as is before taught.

By this rule and the other two rules first declared, you shall easily trie the skale of any Mappe whether it bee true or not, so as you first haue the true Longitude and Latitude of the two places whose distance you seeke to know. And thus I end with Plancius Map, hoping not to offend him with any thing that I haue added thereunto for the better instruction of those that haue not beene exercised in such matters.

And

And yet I had almost forgotten one thing, which is this, I haue here before as you haue read, made mention of drawing certaine perpendicular lines in the former figure of the Demicircle by helpe of your Compasses. Wherefore I thinke it necessary here to set downe the order thereof.

How to make with your Compasses, a perpendicular line to fall from any point giuen vpon another right line, making therewith right angles without the helpe of any squire.

SEt the firme foote of your Compasse in the point giuen, and extend the other foote a little beyond the line right against ỳ point giuen, and draw a secret Arch or portion of a circle that may cut the said line in two points, and deuide that part of the Arch which lieth betwixt the two sections into two equall parts, setting a pricke in the very midst thereof: then hauing laid your rule to that pricke, and also to the point giuen, draw a right line, and that line wil fall vpon the other line with right Angles, as you may see by this figure.



The

The Table of miles answerable to one degree of euery seuerall Latitude.

D	M	S	D	M	S	D	M	S	D	M	S	D	M	S
1	59	59	19	56	44	37	47	55	55	34	25	73	17	33
2	59	58	20	56	23	38	47	17	56	33	33	74	16	32
3	59	55	21	56	1	39	46	38	57	32	41	75	15	32
4	59	51	22	55	38	40	45	58	58	31	48	76	14	31
5	59	46	23	55	14	41	45	17	59	30	54	77	13	30
6	59	40	24	54	49	42	44	35	60	30	0	78	12	28
7	59	33	25	54	23	43	43	53	61	29	5	79	11	27
8	59	25	26	53	56	44	43	10	62	28	10	80	10	25
9	59	16	27	53	28	45	42	26	63	27	14	81	9	23
10	59	5	28	52	59	46	41	41	64	26	18	82	8	21
11	58	54	29	52	29	47	40	55	65	25	21	83	7	19
12	58	41	30	51	58	48	40	9	66	24	24	84	6	16
13	58	28	31	51	26	49	39	22	67	23	27	85	5	14
14	58	13	32	50	53	50	38	34	68	22	29	86	4	11
15	57	57	33	50	19	51	37	46	69	21	30	87	3	8
16	57	41	34	49	45	52	36	56	70	20	31	88	2	5
17	57	23	35	49	9	53	36	7	71	19	32	89	1	3
18	57	4	36	48	32	54	35	16	72	18	32	90	0	0

Though it be the common order of working to know by helpe of the former table, the distance of two places differing onely in Longitude, yet I thinke it a more sure way to find it out per Tabulas Sinuum, the rule whereof is thus.

First take the difference of the two Longitudes, by subtracting the lesser out of the greater, and the halfe of that shall be the Arch which you haue to seeke in the front of the Tables, then multiply the sine of that Arch by the sine of the complement of the common

Latitude

Latitude, and deuide the product therof by the totall sine, the quotient wherof you must seeke out in the Tables amongst the sines, and the Arch of that sine is the one halfe of the distance, which being doubled shall be the whole distance containing degrees of the great Circle, and euery such degree containeth of Italian miles 60. and of German miles 15. and by working thus you shall find the distance betwixt Compostella & Constantinople to be 1846 Italian miles, supposing the common latitude to be 43. degrees, and the difference of their longitudes to be 42. degrees 30. And by working by the common Table you shall finde the distance of those two places to be 1827. Italian miles as before, because the common Table hath no minutes of miles but only seconds, which are not to be accounted of, & in working by Appian his table hauing minutes of miles, you shal find the said distance to be 1892 Italian miles, and by *Mercator* his Map to bee 1980. Italian miles, in whose Map the common latitude of the said 2. places is 43. & the difference of their longitudes is 44.0′. And by the skale set downe in Plancius his Map, you shall find the distance to bee 2520. Italian miles, in which Map the common latitude of the two foresaid places is 42. deg. 30. and the difference of their longitudes is also 42. degrees 30′. Truly I must néds confesse that it is not so easie to make a skale or trunke for a Map or a Carde drawne in plano, as for that which is drawne vpon a round body or Globe: & therfore it is no maruaile though the skales of Maps drawne in plano, and likewise the trunkes set downe in the Mariners Cardes doe not alwaies shew the true distance of places, which I beléue is to bee done as truely and a great deale more readily by my friend Master Wright his Semicircle before described, then by the rules of Gasparus Peucerus in his booke de dimensione terræ, which rules doe depend vpon the knowledge of the quantitie of the Angles and sides of Sphericall Triangles, which kind of working is indéede more troublesome and tedious then ready or pleasant. But if Maister Wright would make his Demicircle an vniuersal instrument to find out therby all the three kinds of distances as he promised me to do, there were no way in mine opinion worthy to be compared vnto it, neither for the trueneste, easinesse, nor readinesse of working thereby.

A very brief and most plaine deſcription of Maſter *Blagraue* his Aſtrolabe, which he calleth the *Mathematicall Iewell*.

Together with diuerſe vſes thereof, *and moſt neceſſarie for ſea men*, written by Maiſter *Blundeuill*.



Imprinted at London by *Iohn Windet*.

To the Readers.

OF Astrolabes I haue neuer seene but three sortes, First that of Stoffierus, which for these hundred yeares past or therabouts, hath bene had in most price & estimation, as an instrument containing all the vses, or at the least the most part of all other Mathematicall Instruments, which because it requireth almost for euery seuerall Latitude a seuerall Table: Gemma Frisius inuented since another kind of Astrolabe, hauing but one Table to serue for all Latitudes, & therefore he called it the *Catholicon*, that is to say, an vniuersall Astrolabe, which hath also beene most esteemed and vsed many yeares. Since whose time, and of very late yeares, one of our owne countriemen a Gentleman of Reading besides London, called M. *Blagraue*, hath greatly augmented the said *Catholicon*, and hath thereby as it were newly inuented a third kind of Astrolabe, which he calleth the Mathematicall Iewell, whereby are to bee wrought more conclusions then by any other one instrument whatsoeuer, for which his most excellent inuentiō vsed therein, hee deserueth great commendation. And to the intent that others which haue not beene exercised in such things, might the more easily attaine to the better vnderstanding of the said Iewell: I haue made a plaine description

cription of all the parts belonging to the ſaid Iewell, without committing any offence (I hope) to the Author thereof, to the intent that euery Gentleman might haue the perfect knowledge and vſe of ſo worthy an inſtrument: But broade Aſtrolabes though they be thereby the truer, yet for that they are ſubiect to the force of the winde, and thereby euer mooning & vnſtable, are nothing meete to take the altitude of any thing, and eſpecially vpon the ſea, which thing to auoide, the Spaniards do commonly make their Aſtrolabes or Rings narrow and waightie, which for the moſt part are not much aboue fiue inches broade, and yet do waigh at the leaſt foure pound, and to that end the lower part is made a great deale thicker then the vpper part towards the ring or handle: Notwithſtanding moſt of our Engliſh Pilots that bee skilfull, doe make their Sea Aſtrolabes or rings ſixe or ſeuen inches broade, and therewith very maſsiue and heauie, not eaſie to bee mooued with euery winde, in which the ſpaces of the degrees bee the larger, and thereby the truer, of which kind of Aſtrolabes or Rings, I ſhall ſpeake hereafter in my Treatiſe of Nauigation, and alſo of the Mariners Croſſe ſtaffe. But whenſoeuer you haue to take the altitude of the Sunne or of any other ſtarre bee it wandring or fixed, I woulde wiſh you to vſe the Mariners heauie & maſsiue Aſtrolabe, which in mine opinion for that purpoſe, is the fitteſt and moſt aſſured inſtrument of all others and to find out all other concluſions by helpe of Maiſter *Blagraue* his Iewell, or rather by help of the Celeſtiall Globe, which for Aſtronomical matters is the perfecteſt iuſtrumēt of all, in which are contained all the ſtars both Southerne and Northerne that haue beene heeretofore knowne, and thoſe that are lately knowne or ſhall be knowne hereafter may be eaſily placed

placed therein: which thing cannot bee ſo well perfourmed in any Aſtrolabe were it neuer ſo great. But becauſe the Globe is comberſome and not portable, and therewith coſtly, and eſpecially if it be of any greatneſſe (for the greater the better) and alſo if it chaunce to be broken in any part of the bodie thereof it can neuer bee made againe perfectly whole, it is therefore no meet inſtrument for euery Mariner to haue, but onely for ſuch as bee of good habilitie, in ſteed whereof to finde out many neceſſary concluſions, Mayſter *Blagraue* his Mathematical Iewell may ſerue very well, and eſpecially if it had on the backe part the like mater and *Rete* or Net, to ſerue to the South Latitude of the world as it hath in the fore parte to ſerue the North latitude, for then I belieue verily, that the chiefeſt Southerne ſtarres, as the Croſſe, the Southerne Triangle, Noahs Doue or Pigeon, and another called Polophilax, lately found out by ſuch as haue trauelled by ſea on the South ſide of the Equinoctiall, might eaſily be placed by Maiſter *Blagraue* in that *Rete*, hauing once learned of the skilfull Seamen the true longitude, latitude and declination of the ſaid ſtarres, ſo ſhould his Iewell in mine opinion bee much more ſeruiceable to the ſea men, then now it is by reaſon that thoſe few ſouthern ſtars that bee contained in the firſt Net, are nothing ſo nigh vnto the South pole, as the Northern ſtars deſcribed in his firſt Net, are vnto the North pole, amongſt which Northerne ſtars, it were very neceſſary for the Sea men, that the ſeuen principall Starres as well of the great Beare as of the little Beare, were all duely placed in his firſt Nette. Truely if Maiſter *Blagraue* his affaires would ſuffer him to take pain herein, I belieue that his Iewell ſhould not be much inferiour to the celeſtiall Globe, which indeede it repreſenteth, and in ſo doing he ſhould greatly profit the ſea men,

and deſerue thereby great good wil and commendations at their handes.

What this word Aſtrolabe ſignifieth.



Before I beginne to deſcribe vnto you the ſaid inſtrument and all other partes thereof it ſhall not be amiſſe to ſhew you what this worde Aſtrolabe ſignifieth.

This worde Aſtrolabe is as much to ſay as the handle or inſtrument of the Starres, by help whereof the manifolde motions and apparences of the heauens and of the Starres therein contayned are knowne, and it is called of ſome a Planiſpheare, becauſe it is both flat and round, repreſenting the Globe or Spheare, hauing both his Poles clapt flat together, the ſhape or figure of which Inſtrument I doe not here ſet downe becauſe the Inſtrument it ſelfe is to be had for a ſmall price in diuers places of London, which if you laye before you when you mind to read this my deſcription thereof here following, I doubt not but that you ſhall find euery parte thereof ſo plainely explaned as you ſhall neede no other teacher to inſtruct you therein, or to help you to vnderſtand any of theſe Concluſions that are to be wrought by that inſtrument, and ſpecially thoſe which I haue here ſet downe, ſuch as the Table following ſheweth, and as I thought moſt meet for ſea men to know, and being throughly exerciſed in them, you ſhall the more eaſily vnderſtand the manifolde and neceſſary concluſions ſet down by Maiſter *Blagraue* himſelf in his own booke, which booke I would wiſh you to buy, and earneſtly to ſtudy the ſame. But now I will firſt deſcribe the ſaid Inſtrument, and then ſhew the vſe therof by ſo many concluſions as are contayned in the table hereafter following.

The description of M. *Blagraue* his Astrolabe, otherwise called the Mathematicall Iewell.

THis Astrolabe is diuided into two parts, wherof the one is called the foreparte, and the other the backepart. The foreparte containeth two principall parts, that is, the Mater, which is vnmoueable, and the Rete which is moueable. Againe, the Mater is enuironed with a great circle, called the Meridian, passing through the 2. Poles of the worlde marked with the letters A. B. and through the two Solsticiall pointes of Cancer and Capricorne marked with the characters belonging to those two Signes, and therefore may very well bee called the Collure of the 2. Solstices. And this circle is diuided by two crosse Diameters into 4. quarters euery quarter containing 90 degrées, so as the whole circumference of the circle is 360. degrées, which degrées do proceed from 90. to 90.

Nowe as touching the 2. crosse Diameters, the one passing through the Center, and also through the two Poles, is the Axletree of the worlde, signifying sometime the first Meridian, and sometime the right Horizon, and sometime the line of sixe houres as well for the Morning as Euening, and then it is the line of East and West, and sometime the line of North and South.

And the other crosse Diameter drawne with red inke, signifieth most commonly the Equinoctiall, and sometime the line of

Eaſt & Weſt, and ſometime the line of the Nozth and South, and eſpecially when you haue to finde out the 12. houſes of heauen, to which end are ſet downe in the outermoſt Meridian theſe 4. Latine wozds, firſt at the Nozth Pole marked with the letter A. Oriens, which is as much to ſay as the Eaſt part: and at the ſouth Pole marked with the letter B. Occidens, which ſignifieth the Weſt part: and at the end of the ouerthwart Diameter, dzawne with red inke, and moſt commonly ſignifying the Equinoctiall, marked with the letter C on the right hand is ſet downe Culmen Cœli, the higheſt part of heauen, which is the South, at which end the Ringle oz handle is faſtened. And at the other ende of the ſaide Diameter, marked on the left hand with the letter D. is ſet downe Imum Cœli, the loweſt parte of heauen, which is the Nozth. And by theſe two croſſe Diameters the whole Mater is diuided into foure quarters, that is, Nozthеaſt, and Southeaſt, Nozthweſt and Southweſt. The Noztheaſt quarter lyeth betwixt Imum Cœli, and the vpper ende of the Axletrée, whereon is wzitten Oriens. And the Southeaſt quarter lyeth betwixt the ſame point and Culmen Cœli, and the Southweſt quarter lyeth betwixt Culmen Cœli and the lower end of the Axltree, whereon is wzitten Occidens, and the Noztheaſt quarter lyeth betwixt the point Occidens and Imum Cœli.

The Meridians and houre lines in ỹ Mater.

Beſides theſe 2. croſſe Diameters the Mater is traced with 180 Meridians which doe paſſe thzough both the Poles, whereof the firſt paſſing thzough the center from Pole to Pole is the Collure of the Equinoxes, becauſe it paſſeth thzough the firſt point of Aries, and the firſt poynt of Libra, and is otherwiſe called the Axletrée, and ſignifieth ſometime the right Hozizon, and ſometime the firſt Meridian from which vpon the Equinoctiall are counted the degrées of longitude both Eaſt and Weſt. And al the foze-ſaid meridians are moſt commonly vſed as houre lines, foz euery 15 th. Meridan, counting from the Limbe, doeth ſignifie one houre, foz 15 degrées do make an houre, and 4. minutes doe make a degrée. And theſe hours at the end of euery 15 th. Meridian are marked in the bodie of the Mater ſomewhat aboue the Tropique of Cancer with Arithmeticall Figures, pzocéding from 1, to 12. fozwarde towardes the right hande, and agayne are marked

red somewhat beneath the Tropique of Capricorne with like Figures procæding backward towardes the left hande. Whereof the vpper numbers doe signifie the forenoone houres, and the lower numbers the afternoone houres, and are placed so as one selfe houre line doth passe through both numbers: for the line of the eleuenth houre in the forenoone serueth also to the first houre in the afternoone, and the forenoone houre of 10. serueth also to the houre of two in the afternoone, and the forenoone of 9. serueth to the houre of 3. in the afternoone: and the forenoone houre of 8. serueth to the houre of 4. in the afternoone, and the forenoon houre of 7. serueth to the houre of 5. in the afternoone, and the fore noone houre of 6. serueth also to the 6. houre in the afternoon, and from thence forth towardes the left hande, 5. serueth to 7. 4. to 8. 3. to 9. 2. to 10. and 1. to 11. as before.

But whensoeuer you haue to finde out any houre amongst the houre lines in the Mater, remember that the Axletrée which passeth through the Center, and also through both the Poles is alwayes the sixte houre both of the morning and euening, from which you shall the more easily finde out any houre that you séke by allowing fifténe Meridians to euery houre, as is before saide. And you haue to note that all these Meridians doe sometime signifie euery one a seuerall oblique Horizon, sauing that the first Meridian or Axletrée signifyeth the right Horizon as hath béene saide before. And to find out in the Mater the horizon of euery latitude, reckon from the axeletrée on both hands so many Meridians as may make vp the number of degrées of your latitude, and that Meridian shall be your Horizon. In counting of which Meridians you shall finde that euery fift Meridian is drawne with a greater blacke line then the rest. Howe ouerthwart these Meridians are drawne 180. Parallels, which proceede from 1. to 90. whose numbers are set downe in the limbe of the Mater thus, 10. 20. 30. 40. and so forth both vpward and downeward, vntill you come to 90. and these parallels are otherwise called the circles of declination as well of the Sunne as of any star. Amongst which there be 2. Parallels painted red, whereof that towardes the North pole signifieth the Tropique of Cancer, and the other towards the South pole the tropique of Capricorne.

Howe to find out y Horizon of euery seueral latitude

The Parallels of the Mater.

The two Tropiques.

corne. Then there is another oblique ouerthwart redde line, which passing through the Center from Tropique to Tropique, signifieth the Ecliptique line, nigh vnto which on ech side are set downe the Characters of the twelue Signes, whereof Aries and Libra are placed at the Center, and Cancer at the one end of the Ecliptique on your right hand, whereas it toucheth the saide Tropique, and Capricorne at the other ende of the saide Ecliptique, on your left hand, whereas it toucheth the said Tropique of Capricorne, and the rest of the signes are orderly placed betwixt the said Tropiques, euery two Signs one against another that haue like declination, as Gemini and Leo, Taurus and Virgo, which are placed betwixt the center and Cancer, then Pisces and Scorpio, and Aquarius and Sagittarius are placed betwixt the Center and Capricorne. And euery Signe contayned in the Ecliptique line is diuided with slaunting back strekes into 15. spaces, euery space contayning two degrees, which maketh 180. degrees, and being doubled, because the spaces are to bee counted both forward and backward, do make in all 360. degrees, which is the whole circuit or longitude of the Ecliptique, and the degrees of the said Ecliptique are larger towards the Limbe than towards the Center, whereby the spaces betwixt Signe and Signe are not equall, but some larger than other some.

The Eclipti k line of the Mater.

And note that vpon the outermost Limbe of the Mater are drawne three circles making two reasonable spaces, both which spaces are diuided into 360. degr. both of them beginning at the North pole. And the degrees in the outermost space of the Limbe beginning at the North pole do procede from 15. to 15. downeward towards your left hand, and so round about the instrument vntill you come to 360. which degrees doe shew the houres of the Equinoctiall. And at the North Pole, whereas the diuision beginneth, is set downe the figure of 6. signifying the sixte houre of the forenoone, then counting fifténe degrees downewarde towards your left hand is set down in ỹ foresaid space the figure of 5. then 4. 3. 2. and 1. And at the end of the Equinoctiall on the left hande is set downe 12. from which procéeding still downewardes are set these numbers of houres, 11. 10. 9. 8. 7. and 6. which 6. standeth at the South Pole, then from thence procéeding

The Limbe of the mater

ding vpwardes are set downe these houres 5. 4. 3. 2. 1. and then 12. which standeth at the end of the Equinoctiall on the right hand from whence proceeding still vpwardes towardes the North pole, are set downe these houres, 11. 10. 9. 8. and 7. and at the Pole it selfe is set downe the figure of 6. as before hath bẽn said, from whence you first began to count. And in the inner space of the same Limbe, the 360. degrees are to be counted by 90. in such sort as the first 90. is placed at the North Pole, the second 90. at the one ende of the Equinoctiall, marked with C. The third 90. at the South pole marked with B. And the fourth 90. at the other end of the Equinoctiall, marked with D. Euery which quarter is to be counted both vpward and downewarde, according as you see the numbers written with Arithmeticall figures, and are placed one aboue another in the said space wherof the vpper figures are somewhat lesser then the nether figures, both of them proceeding from 1. to 90. the greater figures from the Equinoctial vpward to the very Pole, and the lesser Figures from the Pole downeward to the Equinoctiall, and are thus set downe. 10. 20. 30. 40.

A Description of the Nette, called in Latine *Rete*.

THis parte is first inuironed rounde about with a great circle signifying most commonly the Meridian or 90. Azimuth or Verticall circle, and sometime it signifyeth the Equinoctiall, and especially when the Center is taken for the Pole, which Circle is diuided by two Crosse Diameters into foure quarters, euery quarter contayning 90. degrees, which degrees are to bee numbred in the very Limbe of the Rete both vpwarde and downewarde, and of those two crosse Diameters, the one ende marked with the letter A. signifieth the Zenith, and the other ende marked with the letter B. signifieth the Nadir or point opposite, and

the other crosse Diameter marked with the letters C. D. signifieth the Horizon, which for distinctions sake is otherwise called the Finitor, because the Meridians before described in the Water are to be called and vsed sometimes as Horizons, and this Finitor is a prety broade Ruler, the very edge whereof is diuided with small diuisions into 180. degrées, which being doubled by reckoning the same both forwarde and backwarde, (beginning at the Center) doe make vp three hundred and three score degrées.

The Finitor

This Finitor signifieth the Horizon of the Globe, the verie edge whereof being diuided by little short strékes into small portions or degrées is alwaies to be applyed to any seuerall latitude when néde is, and the broader part thereof serueth onely to contayne the numbers that are sette therein both beneath and aboue to knowe thereby the number of euery Azimuth hereafter described, which numbers doe procéde from the Center to the right hande thus, 10. 20. 30. 40. 50. and so forth to 90. Then backwarde towardes the Center are set downe 100. 110. 120. 130. 140. and so forth vntill you come to 180. which is placed at the very Center. Then from thence towardes the left hande are set downe these numbers 190. 200. 210. and so forth vntill you come to 270. and from thence turning againe towardes the center are set downe 280. 290. and so forth vntill you come to 360. placed at the Center.

The Almicanteraths.

And in the said Net are certaine circles, which are Parallels to the foresaid Finitor, procéding towards the Zenith, and are in euery respect like vnto the Parallels described in the Water, and these Parallels are called Almicanteraths, that is to say, circles of Altitude, which beginning at the Finitor doe procéde to the Zenith, marked with the letter A. from 1. to 90. And though there be cut out in the Rete but 30. Almicanteraths, yet for so much as euery space contayned betwixt euery 2. Almicanteraths do contayne 3. degrées, they make in all 90. for 3. times 30. maketh 90. which degrées you may sée set downe in the Limbe of the Rete on both hands thus, 10. 20. 30. and so forth, till you come to 90. which standeth at the very Zenith.

The Azimuthes.

And these Almicanteraths are crossed with other circles called

Azimuthes,

Azimuthes, that is to say, Verticall circles, which passing from the Finitor, do meet all in the Zenith, whereof though in this instrument there be set downe but 12. being 15. degrées distant one from another, yet you must imagine that there be 180. which the degrées set downe in the Finitor, in such manner as is before described doe shew. And you haue to note that if the Sunne bee in the very beginning of the Azimuthes, which is at the Center, then is he full east, and if he be in the 90. Azimuth, then he is full South, and when he is in the 180. then hee is full West, and when he is in the 270. Azimuth, then he is full North.

And if you would haue this account of the Azimuthes to aunswere the Mariners compasse, then diuide the number of the Azimuthes wherein the Sunne is by 11. degrées and $\frac{1}{4}$ which is 15. minutes, and the quotient wil shew the rombe or wind of the Mariners Compasse, so as in your account you proceed from the first Azimuth towardes your right hand, that is, from East to South, and from South to West, and from West to North, and so from thence againe to the East point whereas you first began. Also you haue to note by the way, that these Azimuthes doe sometime signifie the circles of position, the vse whereof you shall finde set downe herafter in the 31. proposition of this Treatise.

Howe to count the Azimuths according to the Mariners Compasse.

In the meane time I will proceed in describing the Zodiaque, of the Rete, which in shape is like to an Egge, called in Latine Figura oualis, the one halfe whereof extendeth towardes the Zenith, and the other towardes the Nadir or point opposite to the said Zenith, in which circle are placed the 12. Signes, whereof the 6. Northern signes, that is Aries, Taurus, Gemini, Cancer, Leo and Virgo are placed in the nether halfe towardes the Nadir, and the other sixe Southerne signes, that is, Libra, Scorpio, Sagittarius, Capricornus, Aquarius, and Pisces, are placed in the vpper halfe of the Zodiaque towards the Zenith, and euery one of these signes are diuided into 30. degrees, which are set downe with Arithmetical Figures in the said Zodiaque thus, 10. 20. 30.

The description of the Zodiaque, of the Rete.

Moreouer, in the said Net are placed certain fixed Starres to the number of 71. whose names here do follow. Caput Ophiuci, that is the head of Serpentarius, Aquila, the Eagle. Caput Engon,

Of starres 71. contayned in the Rete.

gon, the head of Hercules. Cuspis Sagittarij, the shaft of Sagittarius. Palma Ophiuci, the hande of Serpentarius. Cauda Delphini, the tayle of the Dolphin. Romboides Delphini, which is a starre in the Dolphins backe. Cor Scorpionis, the hart of the Scorpion. Frons Borealis, Media, and Australis Scorpionis, the Northern, Southern, and middle front of Scorpio. Lucida Lyræ, the bright Star of Lyra, or Vultur cadens. Lanx Chæle Borealis, & Australis, the North and South starre of the Balance. Corona Gnosiæ, the crowne of Ariadna. Præcedens & sequens caudæ Capricorni, that is, the former and follower in the tayle of Capricorn. Caput Draconis, the head of the Dragon Hastile Bootis, the Borespeare of Arcturus. Cauda Cigni, the tayle of the Swanne. Fomahand, a star in the mouth of the Southerne Fish. Arcturus, a starre betwixt the legges of Bubulcus or Bootes. Humerus Bootis, the shoulder of Bubulcus. Dexter Humerus Cephei, the right shoulder of Cepheus. Crus Pegasi, the legge of the winged Horse. Spica Virginis, the Wheat eare in the hand of Virgo. Tres stellæ in cauda Vrsæ maioris, three starres in the taile of the great Beare. Previndemiatrix, that is Virgo. Cauda Ceti, the taile of the Whale. Andromedæ Scapulum, the shoulder blade of Andromeda. Cingulum Andromedæ, the girdle of Andromeda. Humerus Vrsæ maioris, the shoulder of the great Beare. Coruirostrum, the beake of the Crowe. Coruialia dextra, the right wing of the Crowe. Cauda Leonis, the tayle of the Lyon. Ceruix Leonis, the necke of the Lyon. Cor Leonis, the hart of the Lyon, otherwise called Regulus. Lucida Hydræ, the bright Starre of Hydra. Capita Geminorum, the heades of the two Twins named Apollo and Hercules. Cancer, the Crabbe, Canis minor, the little Dogge. Canis maior, the great Dog. Canopus, a faire starre in the left oare of the Shippe Argus. Humerus dexter Aurigæ, the right shoulder of Auriga. Hircus, the Goate hanging at the backe of Auriga. Hedi, the two little Goats sucking behind at her paps. Humerus dexter Orionis, the right shoulder of Orion. Tres stellæ in cingulo Orionis, three stars in the girdle of Orion. Humerus sinister Orionis, the left shoulder of Orion. Pes sinister Orionis, the left foot of Orion. Oculus Tauri, the Bulles eye.

Pleiades, the seuen little starres in the Buls necke. Extremum Eridani, the last end of the flood Eridanus. Caput Medusæ, the head of Medusa. Dextrum latus Persei, the right shoulder of Perseus. Cornu Arietis, the former Starre of the Rams horne. Venter Ceti, the bellie of the Whale. Iuba Ceti, the mane of the Whale.

And note that all these Starres in the Nette, whose longest tippes or pointes do point from the center outward, towardes the Limbe, are Northerne Starres hauing North declination, and those whose longest tippes do point inwarde from the Limbe towards the Center, are Southerne Starres, hauing Southerne declination. All which Starres are set downe in a Table in the beginning of his thirde booke, which doth not onely shewe their names, but also their longitudes, latitudes, and declinations, their natures, their right ascentions and magnitudes or greatnesse. And whereas both in the Mater, and also in the Rete one selfe Circle is made to haue diuers significations, the cause thereof shal plainly appeare vnto you by the vse of the Astrolabe, in seking to finde out thereby the Propositions of the foresaid booke. Howe to knowe which Stars be North or South.

And besides the partes before described, there is yet another part belonging to the forepart of the Instrument, called the Label, the one ende whereof is fastned to the Center of the Astrolabe, so as it may turne round about, and this Label is diuided into 90. degrees twise set downe therein with Arithmeticall Figures to be reckoned as well from the Center to the point of the Label, as from the point thereof to the Center seruing to diuerse vses, yea the 90. degrees of the Label are sometimes to be repeated 4. times to make vp the number of 360. degrees, as shall hereafter plainely appeare by the 12. proposition, shewing how to finde out the right ascention of any degree or portion of the Ecliptique line. A description of the label.

And remember that the right line drawne from the Center of the Label alongst the inward edge thereof is called the Fiducial line, and is diuided into 90. smal parts called degrees, which line or inward edge is alwaies to be vsed in any proposition, and not the outward edge or backe part of the Label. The fiducial line of the Label.

Thus

Thus much touching the forepart of M. Blagraue his Iewell, with euery particular part thereof, with which forepart I wish you to bee throughly acquainted before you deale with the propositions here following, or with any other proposition contayned in M. Blagraue his booke.

A briefe description of the backe parte of the said Iewel.

IN the Limbe of the backe part is described the Theorique of the Sunne, to know thereby in what signe and degrée the Sunne is euery day throughout the yeare, by laying the Diopter thereto, M. Blagraue calleth it a Ruler, which Diopter is made with two Pinules or square Tablets, each one pearced with two holes, one greater than another, the lesser to take the height of the Sunne by his beame passing through the said lesser holes, and the greater holes doe serue to take the altitude of the Sunne, being somewhat darkened in the day time, so as hee casteth no beame, or els the altitude of any Starre in the night season by loking with your one eie, the other being shut through the two greater holes of the Pinules or Tablets. And the middest of this Diopter is fastned with a pinne to the Center of the Astrolabe, so as the saide Diopter may turne round about, and the middle line of the said Diopter is called the fiduciall line, because it rightly directeth the sight of the eye to the foresaid holes, the degrées of the altitude of the Sun or of any Star are set downe in the outermost space of the Limbe, diuided by 2. crosse Diameters into foure quarters euery quarter containing 90. degrées, the number of which degrées are set downe in the outermost space of the Limbe of the saide backe part with arithmeticall figures right ouer the heades of the said degrées of altitude. And you haue to note, that the perpendicular Diameter signifieth the Meridian, that is, the line of South & north, that is to say, the South point at the ring or handle, and the North at the

the point oppoſite, and the other ouerthwart Diameter ſignifieth the right Horizon, that is to ſay, the line of the Eaſt and weſt, the Eaſt being placed on the left hande, and the Weſt on the right hand. And vnder the Theorique of the Sunne you may drawe as many circles of ſuch reaſonable diſtance one from another, as in the ſpaces thereof may be ſet downe, the yeares of our Lorde, the Dominicall letter for the leape yeare, and the Dominicall letter for the common yeares, the Prime or golden number, the Epact, and on what day of March or of Aprill Eaſter day euery yeare falleth, in ſuch order as M. Blagraue hath himſelfe deſcribed in a Table made of purpoſe in the ſeconde booke of his Iewell the 11. Chapter.

Thus hauing deſcribed euery paticular thing as well in the forepart as in the backe part of the ſaid inſtrument, I will nowe ſhew you how to vſe the ſame, and howe to finde out thereby all the concluſions contained in the Table here next following.

The Table contayning 32. neceſſary concluſions to be wrought by this Aſtrolabe.

FIrſt howe to find out the place of the Sunne (that is to ſay) in what ſigne and degree thereof the Sunne is euery day throughout the yeare, being not leape yeare, and alſo the oppoſite poynt of that degree. Propoſition 1.

How to know the place of the Sunne in the leape yeare, & how to find the leape yeare. Prop. 2.

Howe to take the altitude of the Sunne or of any Starre. Prop. 3.

How to take the Meridian altitude, that is to ſay, the higheſt or greateſt altitude of the Sunne or of any ſtarre. Prop. 4.

How to know the altitude of the Sunne at any houre without ſeeing the Sunne. Prop. 5.

How to know the *Meridian* altitude of the Sunne or of any ſtarre in the Net without ſeeing them. Prop. 6.

How to know the declination of the Sun, or of any ſtarre contayned in the Net. Prop. 7.

How

How to finde out the latitude of any Region diuers wayes. Prop. 8.

How to know the houre of the day by the Sunne, and alſo in what part or coaſt of heauen he is at that inſtant. Prop. 9.

How to finde the riſing and ſetting of the Sunne euery day in euery latitude, and thereby the length of the day, and alſo in what coaſt or parte of the *Horizon* hee riſeth and ſetteth. Prop. 10.

Howe to knowe euery day at what houre the Moone riſeth and ſetteth, and how long ſhe continueth aboue the Horizon and alſo when ſhe is full South. Prop. 11.

How to find out the right aſcenſion of the Sunne, or of any degree or portion of the Ecliptique. Prop. 12.

Another more ready way to find out the right aſcenſion of any degree or portion of the Ecliptique by the Rete. Prop. 13.

How to finde out the aſcentionall difference of the Sunne or of any degree or point of the Ecliptique. Prop. 14.

How to find out the oblique aſcention of the *Sunne*, or of any point of the Ecliptique. Prop. 15.

How to find out the right aſcention of any Arke or portion of the Ecliptique, and therewith to knowe what time it ſpendeth in riſing in a right *Spheare*. Prop. 16.

How to find out the oblique aſcention of any Arke of the Ecliptique in any latitude, and what time it ſpendeth in his riſing. Prop. 17.

How to find out the oblique deſcenſion of any point of the Ecliptique in any latitude. *Prop.* 18.

How to find out the oblique deſcention of any Arke giuen of the Ecliptique, and therewith to knowe the time which it ſpendeth in his ſetting. Prop. 19.

How to knowe the height of any Starre at any houre without ſeeing the ſtarre, and thereby to find out in the firmament all the ſtarres that be deſcribed in the Net, and are to be ſeen with the eye. Prop. 20.

How to find out the aſcentionall difference of any ſtarre. Prop. 21.

How

How to know the oblique aſcention of any ſtar. Prop. 22.

How to know what ſtarres doe neuer riſe nor ſet in any latitude. Prop. 23.

How to knowe at what houre of the day or night any ſtarre riſeth or ſetteth. Prop. 24.

Howe to know howe long any ſtarre continueth aboue the horizon in euery latitude. Prop. 25.

How to find out the ſtarres houre, and thereby to know the houre of the night. Prop. 26.

How to find out the diſtance betwixt any two ſtarres contained in the Net. Prop. 27.

Another way to know the diſtance of any two ſtarres, their longitudes and latitudes being firſt knowne, and alſo by that meanes to finde out the diſtance betwixt any two places vpon the earth. Prop. 28.

How to find out the degree of *Medium Cœli* at any houre of the day, that is to ſay, the degree of the Zodiaque that is in the Meridian at any houre that you ſeeke, and alſo the degree called *Imum Cœli*. Prop. 29.

How to finde out the horoſcope or aſcendent at any time of the day or night, and thereby to haue the foure principall angles of heauen. Prop. 30.

How to find the circles of poſition, and to know how much the Pole is eleuated aboue euery ſuch circle in any latitude, without the knowledge whereof you cannot find out the 12. houſes by this Aſtrolabe. Prop. 31.

How to finde out all the 12. houſes of heauen, and thereby to erect a figure at any houre of the day or night. Prop. 32.

The vſes of the Aſtrolabe, and firſt howe to finde out the place of the Sunne (that is to ſay) in what ſigne and degree thereof the Sunne euery day throughout the yeare, being not leape yeare, and alſo the oppoſite point of that degree.

Propoſition. 1.

LAy the Diopter which is on the backſide of the Aſtrolabe vpon the day of the moneth, and that ende of the Diopter with his fiduciall line will ſhewe you in what ſigne and degrée thereof the Sun is that day, and the other ende of the Diopter will ſhewe you the oppoſite point to that degrée, as for example: I would knowe the place of the Sunne the 17. of July, here by laying the Diopter vpon that day, I finde the Sunne to be in the fourth degrée of Leo, and the oppoſite point thereof to be the fourth degrée of Aquarius.

How to knowe the place of the Sunne in the leape yeare, and how to find the leap yeare,

Propoſition. 2.

WHen it is leape yeare you muſt alwayes adde one degree more euery day during that yeare vnto the place of the Sunne found by the firſt propoſition, which leape yeare you ſhall knowe by diuiding the

yeare

yeare of the Lord by 4. for if there be no remainder left, then that yeare is leape yeare, so shall you find the yeare of our Lord 1596 to be leape yeare.

How to take the altitude of the Sunne, or of any starre.

Proposition. 3.

TO take the altitude in any time of the day when the Sunne shineth, you must turne your face and also the left Tablet or Pinule of the Diopter towardes the Sunne, holding the Astrolabe by the ring with your right forefinger or middle finger being somewhat bowed, in such sort as the Astrolabe may hange plumbe, and then with your left hand lift the Diopter vp and downe vntill the Sun with his beame do iustly stricke through both the holes of each Pinule of the Diopter, so as you may see the shadow of the two holes of the vpper Pinule to play vpon the two holes of the nether Pinule, then marke vpon what degree of altitude the thinnest edge or Fiduciall line of the Diopter falleth in the outermost skirt or border of the backe of the Astrolabe, for that is the Sunnes altitude for that present. But if the Sunne be couered with a cloud, so as it shineth not cleare inough to cast any shadow, & yet so as it may be seene with the eye, then haug the Astrolabe by the ring vppon your right thombe, and turning your face towardes the Sunne, lift vp your hand with the Astrolabe so high, as by moouing the Diopter with your left hand vp and downe, you may with your right eye (the other being shut) see the Sunne through the greater holes of both the Pinules of the Diopter, and marke vppon what degree of altitude the vpper end of the Dioper falleth, and that is the altitude of the Sunne at that time, and in this manner you must also take in the night season, the altitude of any starre.

How to take the Meridian altitude, that is to ſay, the high-eſt or greateſt altitude of the Sunne or of any ſtarre.

Propoſition. 4.

GOe into ſome open place wheras the Sun ſhineth ſomewhat before noonetide, and there hanging the Aſtrolabe vppon your right forefinger or middle finger, take the altitude of the Sunne in ſuch manner as is before taught, at diuers times with ſom pawſe betwixt euery time to know therby whether ſuch altitude increaſeth or decreaſeth, for if it increaſeth, then the Sunne is not yet at the Meridian, but if it decreaſeth, then it is paſt the Meridian, and therefore you muſt watch diligently to take him when he is at the higheſt. And you muſt do the like to take in the night ſeaſon, the Meridian altitude of any knowne ſtarre, ſauing that then you muſt hange your Aſtrolabe vppon your thumbe before your right eye, and to doe as is taught in the laſt Propoſition.

How to know the altitude of the Sun, or of any ſtarre at any houre of the day without ſeeing the Sunne or ſtarre.

Propoſition. 5.

SEt the Finitor at your Latitude, and ſéeke out amongſt the houre lines or Meridians of the Mater in what point the Parallel or Circle of declination of the Sunne croſſeth the houre line which you ſéeke, and the Almicanterath and Azimuth paſſing through that point doe ſhew both the altitude and alſo the coaſt or part of heauen, wherein the Sunne or ſtarre is at that inſtant. This is a very neceſſarie Propoſition, for by knowing the height of the Sunne at euerie

houre

houre of the day in whatsoeuer signe the Sunne is, you may make Tables for particular Dyals, as Cylinders, houre Quadrants, and such like to serue any Latitude, yea rather this Instrument (as Maister Blagraue rightly) sayth is a Table of it selfe ready made to serue such purposes. Let the example of this Proposition be thus, Suppose that at eight of the clocke in the morning the 21. of Aprill 1592. the Sunne being then in the tenth degrée of Taurus, and his declination 15. degrées Northwarde, you would knowe the altitude of the Sunne at that houre, which by working as the rule teacheth, you shall finde to bee 30. degrees, and that he is about 16. degrées distant from the East towardes the South.

How to know the Meridian altitude of the Sunne or of any starre euery day throughout the yeare, without seeing eyther Sunne or starre.

Proposition. 6.

FIrst seeke to knowe the declination of the Sun or star eyther by the seuenth Proposition next following, or else by some table, and whether it be North or South, & knowing his declination, bring the Finitor to your Latitude, and staying it there seeke out in the limbe of the mater on your right hand the said declination, and there marke what Almicanterath toucheth that point, for that Almicanterath being counted vppon the limbe of the Rete from the Finitor, doth by and by shew the Meridian altitude of the Sunne or starre for that day. As for example, I would know the Meridian altitude of the Sunne the first of July 1592. at which time his Parallel or declination is 22. degrées and certaine minutes Northward. Here hauing layde the Finitor to the Latitude 52. I find that the 60. Almicanterath toucheth the Parallel, and that is the Meridian altitude of the Sunne that day. Againe suppose that I would know the Meridian altitude of the starre Oculus Tauri, in

the Latitude 52. Here hauing brought the Finitor to the said latitude, I finde that the 53. Almicanterath toucheth his Parallell or declination, which is 15. degrées 49. Northward, so as I find his Meridian altitude in that latitude to be 53. degrées. But you haue to note that if the sun or starr haue south declination, then you must count his parallel from the Equinoctial downward towards the south Pole, so shall you find the Meridian altitude of the great dogge called Canis maior, whose Southerne declination is 16. degrées to be 22. degr. & 30. And by knowing the Meridian altitude of any starr, you may also know how farre he is distant from the Meridian or South line, if you subtract from his Meridian altitude his altitude taken at any other time of the same night, for the remainder will shew his distance from the Meridian, & if the starre at the time of taking his altitude, be in the East part of the firmament, then he is so much short of the Meridian, and if he bée in the West, then he is so much past the Meridian. As for example knowing the Meridian altitude of Oculus Tauri to be 53. degrées, and his other altitude newly taken to be 30. deg. I find his distance from the Meridian to be 23. deg. aswel by subtraction, as by counting vpon the limbe of the Rete the degrées contained betwixt the two forsaid Almicanteraths. And because the said starr was in the East part of the firmament when I toke his altitude, I conclude that he wanted 25. degrées of arriuing to the Meridian, which maketh one houre and a halfe, and a little more.

How to find the declination of the Sunne, or of any starre described in the net.

Proposition. 7.

THis may be done two maner of waies, first knowing the place of the Sunne, séeke his place in the Ecliptique line of the mater, and looke what Parallel of the Mater passeth through that degrée, and the number of that Parallel will shew the declination (that is to say) how farre the Sunne is distant from the Equinoctiall, counting from the Equinoctial vp-

on the outermoſt Meridian or inner limbe of the mater, and accor-ding as the ſigne wherein the ſunne is be it Northerne or Southerne, ſo is the declination of the ſunne, and muſt be counted eyther vpwarde or downewarde accordingly. The ſeconde way is thus, bring the Fiduciall line of the Labell to the degree of the ſunne in the Zodiaque of the net, and the number of degrées counted vpon the labell betwixt the lymbe of the net, and the place of the ſunne which the labell toucheth vpon the outward edge of the ſaide Zodiaque will ſhewe his declination. By eyther of theſe two wayes you ſhall finde the declination of the Sunne, being in the tenth degrée of Taurus to be 15. degrées Northwarde. And by this laſt way you may knowe the declination of any ſtarre contayned in the net thus. Hauing founde in the net the ſtarre whoſe declination you ſeeke, lay the Fiduciall line of the labell to the longeſt tippe of that ſtarre, then count vpon the labell how many degrées are contayned betwixt the limbe of the *Rete*, and that point whereas the labell toucheth the longeſt tippe of the ſaide ſtarre, and that ſhalbe his declynation eyther Northerne or Southerne according as the ſaid tippe pointeth either outwarde or inward: for if outward from the Centre, then it is Northerne, if inward towards the Centre, then it is Southerne, as hath béene ſaide before in the deſcription of the Net, and by doing thus you ſhall finde that the ſtarre called Canis maior, that is the greater dog, hath in South declination 15. degrées 5'5. Againe you ſhal finde the firſt ſtarre of the Rams horne called Cornu Arietis to haue in North declination 18. degrées.

How to find out the Latitude of any Region.

The 8. Propoſition.



Firſt you muſt know the place of the ſunne, and alſo his declination, and hauing taken his Meridian altitude, reckon the ſame amongſt the Almicanterathes, from the Finitor vpwardes, and turne about the Rete from the Pole Arctique towards the Equinoctiall on your right hande, vn-

till it toucheth the Parallel of the sunne, for then looke on your left hand, and you shall finde the Finitor to stande at that Latitude which you seeke. As for example, the 12. of April 1591. the sunne being in the first degree 20. minutes of Taurus, and his declination being then 12. degrees Northward, I finde his Meridian altitude to be 50. degrees, which I count vpon the limbe of the Rete proceeding from the Finitor vpwardes towards the Zenith, and then I turne the Rete vntill I haue brought that Almicanterath to the Paralel of the Sunne, which is 12. degrees, counting the same from the Equinoctiall on the right hande of the mater towardes the North Pole, and there staying the Rete, I finde that on the left hande the Finitor lyeth vppon the 52. degree of Latitude counting from the North Pole downe towardes the Equinoctiall. The common way of finding the latitude is thus, if it bee in the day time, then take the Meridian altitude of the Sunne, and if the Sunne be in any of the fiue Northerne signes, then subtract the declination of the sunne out of his Meridian altitude and the remainder shall be the altitude of the Equinoctiall aboue your Horizon, which being taken out of 90. the remainder will shew the altitude of the Pole, but if the sunne be in any of the fiue Southerne signes, then you must adde his declination to his Meridian altitude, and the summe thereof shall be the altitude of the Equinoctiall, which being taken out of 90. the Remainder will shew the Latitude or eleuation of the Pole. But to know the latiude of any place in the night season, you must take the Meridian altitude of some knowne starre which both riseth and setteth, then after that you haue taken his Meridian altitude with your Astrolabe, you must learne to know his declination, and whether it be Northerne or Southerne, for if the starre haue north Declination, then you must subtract his declination from his Meridian altitude, and the remainder shall bee the Altitude of the Equinoctiall, which being taken out of 90. shall bee the latitude or eleuation of the Pole, but if the declination of the star be Southernely, then you must adde his declination to his Meridian altitude, and that summe shall be the altitude of the Equinoctial, which being taken out of 90. the remainder shalbe the eleuation of the Pole. And there be diuers other wayes of finding out the latitude

of

of any place, which I haue partly set downe in my treatise of the two Globes about the latter ende thereof, and partly in my Treatise of Nauigation, whereas I speake of the Northstarre and of his guardes.

How to know the houre of the day by the Sunne, and also in what part of heauen he is at that instant.

Proposition. 9.

TAke the altitude of the Sunne, and knowing the latitude of the place where you are, lying the Finitor of the Rete to that Latitude, and hauing stayed it there, looke in what point the Almicanterath or altitude of the Sunne crosseth the Sunnes Parallel or Circle of declination in the mater, and the houre line passing through that point will shew e e true houre, and at that instant you may also know in what Azimuth (that is to say) in what part of heauen, or as the Mariners tearme it in what rombe or winde, as East, West, North, or South &c. the Sunne is at that instant, for that Azimuth which passeth through the foresaide pointe, is the Azimuth of the Sunne. As for example, the 21. of Aprill 1592. the sunne being in the tenth degree of Taurus, and his declination being then 15. degrees Northward, I find by the Astrolabe, Quadrant or Crosse-staffe, the altitude of the Sunne in the forenoone to bee 30 degrees. Wherefore I haue laide the Finitor to my Latitude which is 52. and stayed it there, I marke in what point the Almicanterath cutteth the sunnes foresaide Parallel in the mater, and I find that the houre line of eight in the forenoone cutteth that poynt, which sheweth that it was then eyght of the clock in the morning, and that the sunne was about 15. degrees distant from the East towardes the South.

How to find the riſing, and ſetting of the ſunne euery day in euery Latitude, and thereby the length of the day, and in what coaſt or part of the Horizon he riſeth and ſetteth.

Propoſition. 10

BRing the Finitor to your Latitude and ſtaying it there, looke in the Mater where the Parallel of the Sunne doeth cut the Finitor, and the houre line which crolleth that point, will ſhew the houre of his ryſing and ſetting, & the number of houres betwixt his ryſing and ſetting is the length of the day, and the number of the Azimuthes betwixt that point of the Finitor, and the Centre or firſt Azimuth will ſhew you in what parte or coaſt of the Horizon he both ryſeth and ſetteth. As for example, ſeeking by this rule to know at what houre the ſunne riſeth the 19. of June 1592. hee being then in the firſt degree 39. minutes of Cancer, and his declination then 23. degrees 19. I find that he riſeth 12. minutes before foure, and goeth downe 12. minutes after 8. and thereby I find the length of the day, counting from ſun riſe to ſunne ſet to be 16. houres and 24. minutes, and that he riſeth from the Eaſt towards North 40. degrees, which according to the Mariners reckoning is Northeaſt and by Eaſt two quarters and ſomewhat more towards the North.

Howe to know euery day at what houre the Moone riſeth and ſetteth, and how long ſhe continueth aboue the Horizon, and alſo when ſhe is full South.

Propoſition. 11.

FIrſt you muſt learne by ſome Almanacke or Ephemerides, in what ſigne and degree the Moone is, and whether it bee a Northerne ſigne or Southerne ſigne, for if ſhe be in a Northerne ſigne, then bring her place to the

the Horizon of your latitude in the northeast part of the Astrolabe, but if she be in a Southerne signe, bring her place to the said Horizon in the Southeast parte of the Astrolabe, and there hauing stayed the Rete bring the labell to the place of the Sunne for that day, and the labell will point to the houre of the Moones rising in the limbe of the Mater: but because the Almanack or Ephemerides doo not set downe the true place of the Moone but onely at noone, you must therefore consider whether it bee in the forenoone or in the after noone that you seeke, for if it be in the afternoone you had neede to know how many houres are run from noone, and then for euery houre to adde halfe a degree to the place of the Moone which you found at noonetide, but if it be in the forenoon, then you must subtract from her place at noone, for euery houre halfe a degree, so shall you go very nigh to finde her true place in the Zodiaque for that houre, though you know not her latitude which is but 5. deg. at the most, and therfore can cause no great error in this matter. Now to know when she setteth you must do thus, if the Moone be in any Northern signe, then you must bring her place to the foresaid Horizon in the Northwest part of the Astrolabe, & by laying the label to the place of the Sunne, it wil point to the houre of her setting, but if she be in any Southerne signe, you must bring her place to the Horizon in the Southwest part of the Astrolabe, & the labell being laid to the place of the Sun will point to the houre of her setting. Now if you wold know how long time she is aboue the Horizon, and also at what houre she is full South, then count the hours betwixt her rising and setting, and that shal be the time of her continuaunce aboue the Horizon, and the very middest of that is the true houre that she is full South. As for example, the fourth day of September 1592. in the latitude 52. at nine of the clocke at night the Sunne being in the 21. degrees 47. of Virgo or there abouts, and the Moon being in the 2. degree 30. of Capricorne, I am desirous to know when the Moone did rise that day, and by working according to the rule before set downe, I founde that she did rise about three of the clocke in the afternoone, and that she went downe at tenne of the clocke at night and halfe an houre past, and that she was full South or at the Meridian a little before seuen of the clocke in the afternoone. And as by this rule you

map

may finde out the time of the rising and setting of the Mone, so may you finde the time of the rising and setting of the other fiue Planets, that is Saturne, Iupiter, Mars, Venus, and Mercury, any day throughout the yeare, so as you know their places in the Zodiaque, which the Ephemerides of Stadius doth shewe, not onely at noonetide, but also at any other houre of the day by helpe of certayne Tables made of purpose, the vse of which Tables I haue set downe in the latter end of my Treatise of the two globes.

How to find out the right ascention of the Sunne, or of any degree or portion of the Ecliptique.

Proposition 12.

TAke the Rete and the label cleane from the Astrolabe, and seeke out in the Ecliptique line of the mater the signe and degree whose right ascention you would know, and marke what meridian cutteth that point: that done, place the labell vpon the pinne which standeth in the very Centre of the Iewell, and make the fiuctall line thereof to lie right vppon, and alongest the Equinoctiall line eyther towardes your right hand or towards your left, according as the signe & degree whose ascention you seeke is placed in the mater. Then marke where the foresaid Meridian cutteth through the label, and also through the Equinoctiall line and the number of degrees contayned in the label, betwixt the Centre and that point of the Equinoctial is the right ascention of that degree of the Ecliptique which you seeke, which number of degrees you must count vpon the labell in this maner. For if that signe and degree be contayned betwixt the first point of Aries and the first point of Cancer, then you must begin to count vpon the labell at the Centre, and so procede forwarde towards Cancer, the right ascention of whose first point is 90. degrees, but if the signe and degree which you seeke, bee betwixt the beginning of Cancer, and the beginning of Libra, which is at the very Centre right against Aries, then you must count vpon

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the labell backward from 90. to 180. by adding to euery tenth space of the labell 10. degrees, so as the first number proceeding towards your left hand shall be 100. and next to that 110. and so forth vntill you come to 180. which is the right ascention of the first point of Libra, and from Libra you must count toward Capricorne 190. then 200. and so forth till you come to 270. which is the right ascention of the first pointe of Capricorne: and from thence you must count 280. 290. then 300. and so forth towards the Centre vntil you come to 360. which is the right ascention of the last point of Pisces, so as though there bee set downe in the labell but 90. degrees both forward and backwarde, yet 90. being foure times repeated, doe make in all 360. which is the whole Longitude of the Equinoctiall. As for example, you would know perhaps the right ascention of the tenth degree of Sagittarius, here by seeking in the mater you shall find that the Meridian passing through that degree will cut both the labell being layde towards your left hande, and also the Equinoctiall in the 248. degrees 21. minutes, which is the right ascention of the tenth degree of Sagittarius, in counting whereof remember to beginne from 180 that is from the Centre, and this ascention agreeth with the Table of right ascentions set downe in Stadius his Ephemerides the 44. page of his booke. Againe in seeking to know the right ascention of the 10. degree of Taurus, if you beginne to count vpon the labell from the Centre, which is the first point of Aries, you shall finde that the Meridian which passeth through the 10. degree of Taurus will cut the labell, and the Equinoctiall line in the 37. degree 35.

Another more ready way to find out the right ascention of any degree or portion of the Ecliptique by the Rete.

Proposition. 13.

LAy the Finitor eauen with the Arietree, signifying here the right Horizon, so as the first point of Aries may meet with the East point of the said Horizon, and lay the labell right vpon and alongest the Equinoctiall line, eyther towardes Cancer or towardes

wards Capricorne, according as the ſigne and degrée which you ſéeke is placed in the Ecliptique of the Mater, and marke therewith what Meridian paſſeth through that degrée, and follow the ſame vntill it cutteth the Equinoctiall, and alſo the labell lying thereon, and by counting vppon the labell the number of degrées to that point in ſuch order as is before taught, you ſhal haue your deſire. As for example, if you ſeeke to knowe the right aſcention of the tenth degrée of Leo, here hauing placed the Finitor as before is taught, ſéeke out in the Mater what Meridian paſſing through that degrée cutteth the ſaid Equinoctial, & in what point, & lay the label to the ſaide Equinoctial according as the ſigne requireth, be it towards Cancer or Capricorne, & by counting the degrées vpon the labell as is before taught, that is from 90. proceéding from the limbe backwarde towardes the Centre you ſhall finde the right aſcention of the 10. degrée of Leo to bee 132. degrées, which differeth from the foreſaid Table but 2′7. a thing of ſmall moment conſidering the narrowe ſpaces of the Meridians in the Mater.

How to find out the aſcentional difference of the Sunne, or of any degree or point of the Ecliptique.

Propoſition. 14.

BRing the Finitor to your latitude, and there ſtaying it looke amongſt the Meridians in the Mater in what pointe the Parallel of the Sunne cutteth the Finitor, and the number of the Meridians contained betwixt the Axletrée, and that point ſhalbe ỳ aſcentional difference. As for example, in the Latitude 52. I would knowe the aſcentionall difference of the Sunne being in the fourth degrée of Cancer, at which time his Parallel of declination is 23. degrées Northward, here by working according to the rule I find the aſcentionall difference to be 33. degrées 3′0.

How

How to finde out the oblique aſcention of the Sunne or of any point of the Ecliptique.

Propoſition. 15.

HAuing found the right aſcention and alſo the aſcentionall difference by the former Propoſitions, conſider whether the declination of the Sunne or of any other point of the Ecliptique be North or South, for if it be North, then ſubtract the aſcentionall difference out of the right aſcention, and the remainder ſhall be the oblique aſcention. But if the declination bee South, then adde the aſcentionall difference to the right aſcention, and the ſumme thereof ſhal be the oblique aſcention. As in the former example knowing the declination of the Sunne to be 23. degrees Northward, I ſubtract the aſcentionall difference which was 33 degrees 30. minutes, out of the right aſcention of the Sunne, which was 94. degrees, and there remaineth 60. degrees 30. which is the oblique aſcention of the Sun being in the fourth degree of Cancer, and his declination being 23. degrees Northward as is before ſuppoſed.

How to finde out the right aſcention of any arke or portion of the Ecliptique, and therewith to knowe what time it ſpendeth in ryſing in a right Spheare.

Propoſition 16.

BRing the ende of the giuen Arke founde out in the Zodiaque of the Rete, vnto the left ende of the Equinoctiall marked with D. and there ſtaying it, laye the Fiduciall line of the labell vpon the beginning of the ſaide Arke, and the number of degrees in the innermoſt limbe

of

of the Mater contained betwixt the left ende of the Equinoctiall, and the Fiduciall line of the labell ſhall bee the right aſcention of that Arke, and the houre ſet downe in the outermoſt limbe whereunto the labell pointeth, ſhall be the time which the ſaid arke ſpendeth in his ryſing, ſo ſhall you finde the Arke of the whole ſigne Taurus to be 30. degrees, and to ſpend in his riſing two houres.

How to finde out the oblique aſcention of any Arke of the Ecliptique in any Latitude, and what time it ſpendeth in his ryſing.

Propoſition. 17.

FInd the oblique aſcention both of the beginning and ending of the Arke by the 15 Propoſition, then ſubtract the ſaid aſcention of the beginning of the arke out of the aſcention of the ending of the ſaide Arke, alwayes remembring that if the oblique aſcention of the beginning be greater then the other, then to adde to the leſſer 360. and out of that ſumme make your ſubtraction, for the remainder ſhall bee the oblique aſcention of the whole Arke, then count the number of that aſcention in the innermoſt limbe of the Mater beginning at the left ende of the Equinoctiall marked with D. and ſo procéde vpward towards your right hand, and where the ſaid aſcention endeth, there laye the labell, and the houre whereunto the labell pointeth ſheweth the time which the ſaide Arke ſpendeth in his ryſing in that Latitude. As for example, I would know the oblique aſcention of the whole Arke of the ſigne of Taurus, and what time that Arke ſpendeth in his ryſing: firſt heere hauing found the oblique aſcention of the firſt point of Taurus to be about 13. degrées in the Latitude 52. and the oblique aſcention of the laſt point of that ſigne to be about 30. here by taking 13 out of 30. there remaineth 17. degrées, which is the oblique aſcention of the whole Arke of the ſigne Taurus, which 17. degrées,

I count

I count in the limbe of the mater from the end of the Equinoctiall marked with D. vpward, and there laying the label, I finde that it pointeth to one houre and two degrées, which maketh 8'. so as I conclude thereby that the whole Arke of the signe Taurus, spendeth in his oblique ascention one houre and eight minutes.

How to find out the oblique descention of any point of the Ecliptique in any Latitude.

Proposition. 18.

HAuing found out the oblique ascention of the pointe opposite to the point giuen, adde thereunto 180. degrées, and the summe thereof shall be the oblique descention of the point giuen, alwayes remembring if the summe of Addition doe excéde 360. to subtract out of that summe 360. and the remainder shall be the descention of the point giuen. As for example, you would know the oblique descention of the first point of Taurus, whose point opposite is the first point of Scorpio, and his oblique ascention according to Reynholdus his Tables is 222. degrées 36. minutes, whereunto if you adde 180. you shall make the totall summe to be 402. degrées 36. minutes, from which summe if you subtract 360. degrées according to the rule before giuen, there will remaine 42. degrées 36. minutes, which is the oblique descention of the first point of Taurus.

How to find out the oblique descention of any Arke giuen of the Ecliptique, and therewith to knowe the time which it spendeth in his setting.

Proposition. 19

HAuing found the oblique descention of the beginning, and also of the ending of the giuen Arke by the last Proposition subtract the descention of the beginning out of the descention of the ending, and the remainder:

der shall be the oblique descention of the giuen Arke, alwayes remembring if the subtraction cannot bee made to adde thereunto 360. that done, deuide that by 15. and the quotient will shew the number of houres which the giuen Arke spendeth in his setting: and remember that if in making that diuision there bee anye remainder left, to multiply that remainder by foure, and so you shal haue the minutes. By working thus you shall finde the oblique descention of the whole Arke of Gemini to bee 36. degrees 49. minutes, and in the Latitude 52. to spend in his going downe two houres and 24. minutes.

How to know the height of any star at any houre, without seeing the starre, and thereby to find out in the firmament all the starres that bee described in the net, and are to bee seene with the eye.

Proposition. 20.

LAy the labell to the houre supposed vppon the limbe of the Water, and then bring the place of the Sunne for that day to the Fiduciall line of the labell, and there hauing stayed the Rete, bring the Fiduciall line of the labell to the tippe of the star whose altitude you seeke, and the labell wil shew you vpon the limbe of the Water how many degrees that starre is distant from the South. Againe by counting vpon the label, the degrees contained betwixt the point of the labell, & the tip of ẏ said star you shal haue his declination, which is North or South according as the starre is Northerne or Southerne. Then bearing in mind, as well the stars distance from the South, as also his declination work thus, Bring the Finitor to your Latitude, and vpon the stars Parallel or Circle of declination in the Water count from the limbe of the Water, the distance of the starre before found, and mark what Almicanterath crosseth that point, for ther is the altitude of the star at that instant, and the Azimuth which cutteth that point, sheweth

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in what part or coast of heauen the starre is at that present. And remember to seeke the Parallell of the starre on that side of the Water either on your right or left hand, so as it may fall amongst the Almicanterathes, for otherwise you shall not finde that you seeke. As for example the 26. of October 1591. at nine of the clock at night, you would know the height of the first star of the Rams horne called Cornu Arietis the Sunne being then in the 12. degrees and 12. minutes of Scorpio. Here after that you haue laide the label to the houre supposed, and brought the degree of the Sunne for that day to the Fiduciall line of the label, and staied the Rete there, bring the label to the tippe of the starre in the Rete, and the label will shew in the limbe of the Water how many degrees the starre is distant from the South, which you shall finde to bee 28. degrees and 30. minutes, and the declination of the saide starre being counted vpon the said label, to be 18. degrees, then keeping those two numbers in minde, bring the Finitor to your Latitude supposing the same to bee 52. degrees, and there staying the Rete, seeke for the Parallell of the starre which is 18. degrees on your right hand, and vpon that Parallell count by the Meridians from the limbe inward, the starres distance from the South, which is 28. degrees 30. minutes, and you shall finde that the 49. Almicanterath cutteth that point, so as you may conclude that the altitude of the starre called Cornu Arietis, was at that houre 49. degrees, and that the 47. Azimuth doth also passe through that point which sheweth that the starre is 47. degrees from the East towards the South, which according to the Mariners account is Southeast, and somewhat more to the Southward. Now to finde out the said starre in the firmament, if it bee a star light, you haue no more to doe but to lay the Diopter of your Astrolabe at that altitude, and to turne your face towardes that coast (that is to say) Southeast and somwhat more to the Southward, and the next bright starre which answereth in that coast to that altitude is the starre which you seeke.

How to finde out the ascentionall difference of any starre.

Proposition. 21.

BRing the Finitor to your Latitude, and staying it there, looke in what point the Parallel of the starres declination cutteth the Finitor, and the number of ỹ Meridians contained betwixt that point and the Centre, is the ascentionall difference, so shal you find the ascentional difference of the Buls eye called Oculus Tauri, whose declination is 15 degrees 4′8. to be 21. degrees.

How to know the oblique ascention of any starre.

Proposition. 22.

IF the declination of the star be Northern, subtract the ascentionall difference out of the right ascention, & the remainder shall be the oblique ascention of the starre, but if his declination be Southerne you must ad the ascentionall difference to the right ascention, and that shal be the oblique ascention of the starre. As for example, because Oculus Tauri is a Northy starre, subtract his ascentionall difference which is 21. degrees, out of his right ascention which as the foresaid Table sheweth is 62. degrees 3′0 and there will remaine 41. degrees 3′0. which is the oblique ascention of the said starre. But if it were a South starre as Spica Virginis, whose declination is almost 9. degrees Southwarde, and her ascentionall difference is 11. degrees 3′0. then you must ad the ascentionall difference to her right ascention, which is 195. degrees 5′1. so shall you finde her oblique ascention to bee 207. degrees 2′1.

How

How to knowe what ſtarres doe neuer ryſe nor ſet in anye Latitude.

Propoſition. 23.

IF the ſtarre be a Noꝛth ſtarre hauing a greater declination be it neuer ſo little, then is the altitude of the Equinoctiall anſwerable to your latitude: As foꝛ example, ſuppoſe your latitude to be 52, which if you take out of 90. then the remainder is 38. degrees, which is the altitude of the Equinoctiall anſwerable to that Latitude, otherwiſe called the complement, then that ſtar neuer ſetteth in that Latitude: Againe if it bee a South ſtarre hauing greater declination neuer ſo little then the complement of your Latitude, then that ſtar neuer riſeth aboue your Hoꝛizon. As foꝛ example, in the latitude 52. the ſtarre called Hircus, that is the Goate, being a Noꝛth ſtarre neuer ſetteth in that latitude becauſe his Noꝛth declination is 45. degrees, which is greater then the complement of your Latitud by 7. deg. Alſo the ſtar called Lyra, whoſe declination is 38. degrees, like vnto the complement of your latitude doth neuer ſet, but only toucheth your Hoꝛizon aſwell at his riſing as ſetting, ſo contrariwiſe the ſtar called Canopus, being a South ſtar hauing 51. degrees, 38. of South declination, neuer riſeth aboue your Hoꝛizon in the foꝛeſaid latitude 52. And by this rule you may iudge in like maner of all the reſt of the fixed ſtarres both Noꝛth and South.

How to know at what houre of the day or night any ſtarre riſeth or ſetteth.

Propoſition. 24.

FIrſt marke by the outward oꝛ inward ſhooting of the longeſt tippe of the Starre, whether it bee Noꝛth oꝛ South: foꝛ if it bee Noꝛth, then count amongeſt the Meridians in the Mater ſo many Meridians as your

Latitude amounteth to, beginning at the Axletrée, and so proceeding towardes the Northeast, which is betwixt the North pole and the Equinoctiall on your left hand, but if the star be South, then count your Latitude procéding from the said Axletrée towardes the Southeast, which is betwixt the ringle & the North pole on the right hande, and bring the tippe of the starre to that Meridian which now signifieth your Horizon, and there staying the Rete, bring the labell to the place or degrée of the Sunne in the Zodiaque of the Rete, in which the Sunne is that day you séeke, and the houre in the limbe whereto the labell pointeth, is the houre at which the starre ryseth that day or night. Nowe to know when the same starre setteth, you haue no more to doe but to worke with the starre in the Northwest part in such order as you obserued before in the Northeast part of the Astrolabe. As for example, I would know at what houre the Buls eye called Oculus Tauri, doth rise the last day of June, the Sunne being then in the 17. degrée and 40. minutes of Cancer. Here because this starre is a North starre, I bring the longest tippe thereof to the 52. Meridian which is our Latitude counting from the Axletrée towardes the Northeast part of the Astrolabe which is on my left hand, for that Meridian is alwayes the Horizon seruing the Latitude 52. and there staying the Rete, I bring the Fiduciall line of the labell to the place of the Sunne which at that day is the 17. degree 40. of Cancer as I saide before, and I find that the label pointeth to one of the clocke 30, after midnight wherefore I conclude that Oculus Tauri riseth that day at that present houre. Now to know at what houre that Starre goeth downe, the same day I bring his longest tippe to the said Horizon towards the Northwest, and staying the Rete there, I lay the labell to the 17. degree 40. of Cancer as before, so that the labell pointeth to foure houres and 20. minutes in the afternoone, at which time he goeth downe, so as hee continueth at that time aboue the Horizon in the Latitude 52. 14. houres 48, minutes. And to know the abode of any starre aboue the Horizon, the next Proposition doth also shew.

How

How to knowe how long any ſtarre continueth aboue the Horizon in euery Latitude.

Propoſition. 25.

BRing the Finitor to your Latitude, and looke in what point the Parallel or declination of the ſtar cutteth the Finitor, and the number of the meridians in the Mater contained betwixt the limb and that point doe ſhew the halfe time of his abode aboue the Horizon, which being doubled is the whole time of his abode aboue ꝑ Horizon. And in nũbring the ſaid Meridians wherof 15. do make an houre, remember to begin to count frõ the right ſide of the Mater, proceéding towards your left hand, & remember alſo that the middle Meridian or Arietreé, ſignifieth alwaies the ſixth houre, ſo ſhall you not erre in your account. As for example, hauing brought the Finitor to the Latitude 52. look in what point the Parallel of the foreſaid ſtarre Oculus Tauri cutteth the Finitor, & by numbring the Meridians proceéding from the limbe on your right hand towardes the left, you ſhall finde the Parallel of Oculus Tauri, being 15. degreés 4′9. to cut the 111. Meridian, which being doubled, and then the ſumme thereof deuided by 15. maketh 14 houres and 4′8. as before.

How to finde out the ſtarres houre, and thereby to knowe the houre of the night.

Propoſition. 26

FIrſt hauing taken the ſtarres altitude, ſet the Finitor to your Latitude, and looke at what houreline in the Mater that ſtarres Almicanterath and the Parallel of his declination do meéte, & hauing ſought out the ſame houre in the limbe right a-

gainſt that point, bring the labell thereunto, for that is the ſtars houre, and there ſtaying with your fingers ende the very point of the labell, bring the longeſt tippe of the ſtarre to the Fiduciall line of the labell, and ſtaying there the Rete, turne the labell to the degrée of the Zodiaque of the ſaid Rete, wherein the Sunne is that day, and the labell will point to the true houre of the night ſet downe in the outward limbe of the Water. As for example, I ſuppoſe that the ſeuenth of October 1591. the Sunne being then in the 23. degrée 15. of Libra, I tooke the altitude of the ſtarre *Hircus*, that is the Goate, which I found to be 20. degrées, here hauing ſet the Finitor to my Latitude 52. I looke in the Water at what houre line that Almicanterath, and the Parallell of the ſame ſtarre which is 45. degrées Northward doe méete or croſſe one an other, and I finde that they méete iuſt vppon the fourth houre line of the forenoone, wherefore I ſéeke right againſt that point the ſame houre in the outermoſt limbe of the Water, for that is the ſtarres houre, and hauing placed the labell at that houre, I ſtaye it there with my finger vntill I haue brought the longeſt tippe of the ſtarre Hircus vnto the Fiduciall line of the labell, and there ſtaying the Rete, I turne the labell to the degrée of the Sunne which is 23. degrees 15. minutes of Libra, and I ſee that the labell pointeth to the ſeuenth houre of the night ſet downe in the limbe of the Water and halfe an houre paſt. Maiſter Blagraue ſaith that the ſooner you take the altitude of the ſtar whereby you ſéeke to know the houre of the night, you ſhall haue ỳ houre more truely.

How to finde out the diſtance betwixt any two ſtarres contained in the Net.

Propoſition. 27.

FIrſt conſider whether the declination of both ſtars bee eyther South or North, or that the one bee South and the other North, for if both their declinations bee South or North, then you muſt not leaue to turne the Rete to and fro vntill you haue brought

brought the longest tippes of both starres to one selfe Meridian in the Water, that done, count vpponthe said Meridian how many degrées are contained betwixt the tippes of the said starres, for that is the distance betwixt them. But if the one starre haue North declination and the other South, then turne the Rete to and fro vntill both starres doe lie vpon two such seuerall Meridians as ech of them is equally distant on ech hand from the Axletrée, then count how many degrées or Meridians are contayned betwixt the Axletree and either of those stars (which you will) and that is their distance, so shall you find the distance betwixt Oculus Tauri and Canis minor being both North stars to be 46 degrées 20. and the distance betwixt Oculus Tauri and Canis maior, whereof the first is a North starre, and the other a South starre to bee iust 46. degrees.

Another way to know the distance of any two stars, their Longitudes and Latitudes being first known, and also by that meanes to finde out the distance betwixt any two places vpon the earth.

Proposition. 28.

FIrst seéke to knowe the difference of their Longitudes by subtracting the lesser longitude out of the greater, then count that difference from the outermost Meridian of the Water towardes the Center, and marke well that Meridian at which your account endeth, then number vppon the limbe of the Water from the Equinoctiall the greater Latitude eyther Northwarde or Southwarde according as the Latitude is, and to that pointe bring the Zenith of the Rete, then vppon the selfe same Meridian before marked count from the Equinoctiall the lesser Latitude, and looke what Azimuth passeth through that point, for the degrees which are contained betwixt that point and the Zenith shall bee the distance: and thus doing you shall finde the distance

betwixt Oculus Tauri and Canis maior to bee 46. degrées and 1'5. and the diſtance betwixt London and Venice to be 12. degrées and 2'0. which 12. degrées being multiplyed by 60. maketh 720. miles, whereto if you adde for the 2'0. 20. miles, it will make in all 740. miles.

How to find out the degree of *Medium cæli* at any houre of the day (that is to ſay) the degree of the Zodiaque that is in the Meridian at any houre that you ſeeke, and alſo the degree called *Imum cæli*.

Propoſition. 29.

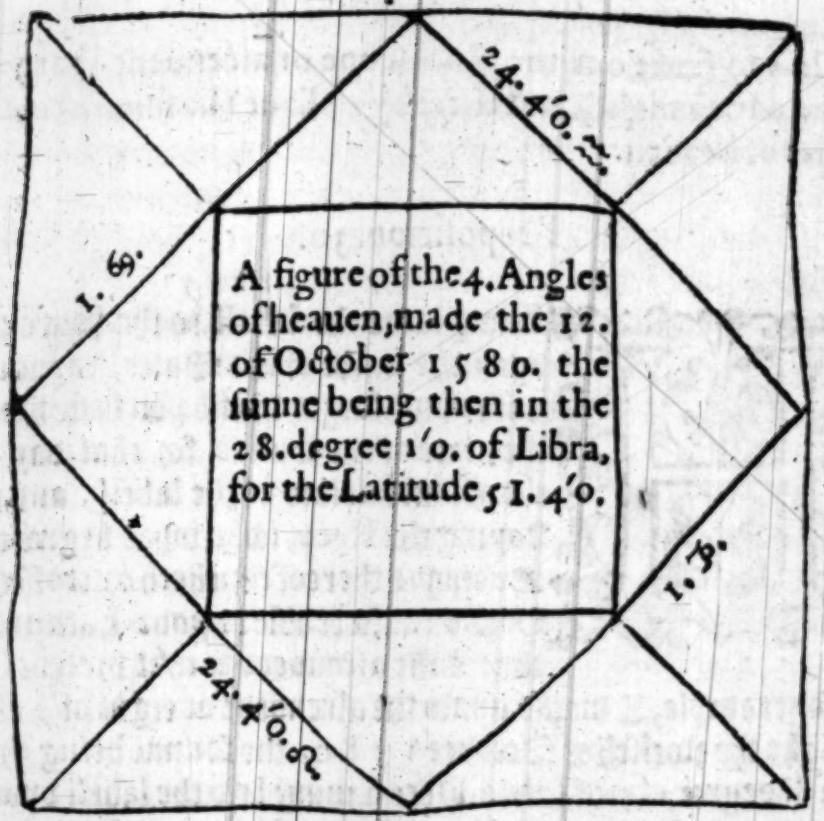
FIrſt ſéeke out the place of the Sunne for that day in the Zodiaque of the Rete, and hauing laid the labell to the houre ſuppoſed vpon the limbe of the Mater, bring the place of the Sunne to the Fiduciall line of the labell, and there ſtaying the Rete, looke what degrée of the ſaid Zodiaque cutteth the noone line or Meridian at noonetide, which you ſhall eaſily find by laying the labell to the houre of 12. at noone, for the Fiduciall line of the label croſſing the Zodiaque, will ſhew the degrée of mid heauen at that houre. As for example, the 26. of June 1592. I would know the degrée of Medium cæli, at eight of the clocke in the morning, the Sunne being that day in the 14. of Cancer. Here by laying the labell to the ſaide houre in the limbe of the Mater, I bring the place of the Sunne to the Fiduciall line of the labell, and there hauing ſtayde the Rete, I bring the Labell to the twelfth houre at noone, and I find that the labell cutteth the Zodiaque of the Rete in the 18. of *Taurus*, which at that houre is the degrée of *Medium cœli*, whoſe point oppoſite is the 18. degrée of *Scorpio*, and that is at that houre Imum cœli which the labell being laide to the twelfth houre of midnight will ſhew.

How

How to finde out the Horoſcope or aſcendent at any time of the day or night, and thereby to haue the foure principall angles of heauen.

Propoſition. 30.

HAuing laide the labell to the houre giuen vpon the limbe of the Water, ſtay it there with your finger vntill you haue brought the place of the Sunne for that day vnto the Fiduciall line of the labell, and there ſtaying the Rete, looke what degrée of the Zodiaque thereof toucheth or croſſeth the Horizon anſwerable to your Latitude, for that is the aſcendent at that preſent hour. As for example, I would know the aſcendent at eight of ỳ clocke at night the twelfth of October 1580. the Sunne being then in the 28. degrée 1′4. of Libra. Here hauing laid the labell vpon the ſaid houre, I bring the 28. degrée 1′0. of Libra to the Fiduciall line of the labell, and there ſtaying the Rete, I find by helpe of the labell that my Horizon which is the 51. Meridian, and 4′0. counting on both handes from the Axletrée, that the firſt degrée of Cancer, doth croſſe my Horizon in the Northeaſt quarter, wherfore I affirme that to bee the aſcention or firſt houſe, whoſe point oppoſite being the firſt of Capricorn, is the deſcendant or ſeuenth houſe, then by bringing the Fiducial line of the label to the South end of the Equinoctiall at which the ringle hangeth, I finde by helpe of the labell that the 24. degrée 4′0. of Aquarius cutteth the Equinoctiall, which is the tenth houſe or Culmen cœli; whoſe point oppoſite being the 24. degrée 4′0 of Leo, is the fourth houſe otherwiſe called Imum cœli, and thus you haue all the foure principall houſes of heauen for that houre, as you may ſée in this figure here following.



But the difficultie of finding out the true ascendent consisteth in knowing whether it is to be sought in the Northeast quarter, or in the Southeast quarter of the Jewell. The Northeast quarter is that which lyeth betwixt Imum cœli, and the North Pole or East end of ỳ Arietree, because in this case the arietree signifieth the line of East and West, and the Equinoctial signifieth the line of South and North, at the South ende whereof is fastened the ringle or handle. But in the former example you may plainely see that the North part of the Zodiaque of the Rete doth cut the Horizon, as well in the Northeast quarter as in the Southeast quarter with two seuerall degrees & signes, for in the Northeast quarter the Zodiaque cutteth the Horizon with ỳ first of Cancer which is the ascendent, and in the Southeast quarter it cutteth the Horizon with the eight of Taurus, which is not the ascendent: for you haue to vnderstand that euery degree of the Zodiaque doth both rise and set either towards the North or towards the south, the first point of Aries and of Libra onely excepted, both which do rise right East, and goe downe right West, euen as the Equi-

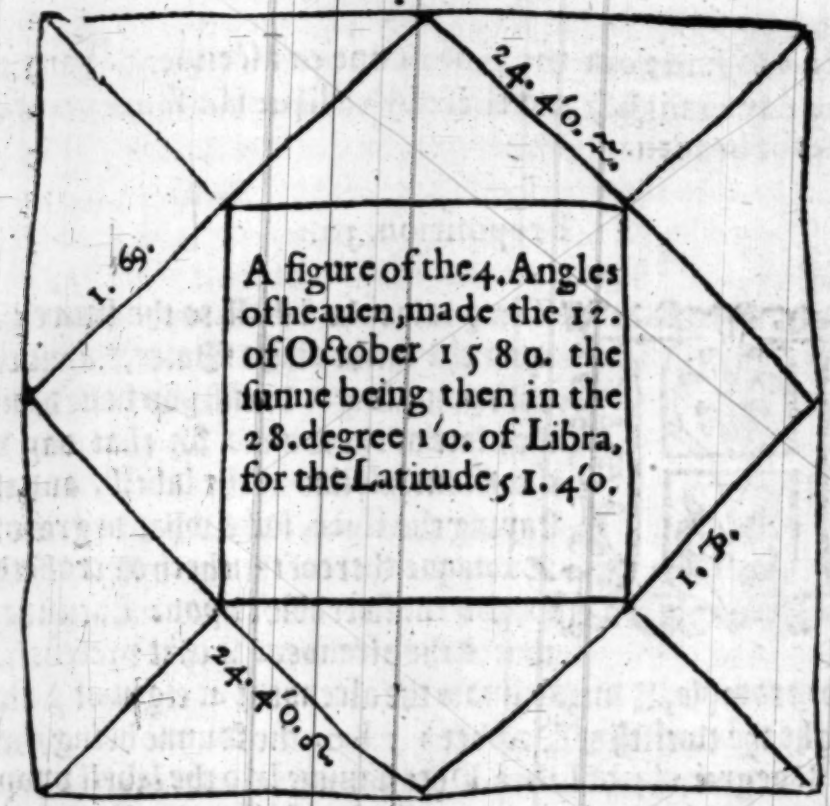
noctiall

noctiall doth, whereof M. Blagraue doth gather a rule how to find out by his Iewell when the aſcendent is to be ſought either in the northeaſt quarter of the Water, or in the ſoutheaſt quarter, which is thus: The aſcention of any of the ſixe Northerne ſignes is to be ſought for in the Northeaſt part of the Iewell, & the aſcention of any of the ſixe Southern ſignes is to be ſought for in the ſoutheaſt part of the Iewell. For although that the North part of the Zodiaque of the Rete containing the 6. Northern ſignes cutteth the Horizon anſwerable to your Latitude, aſwel in the Northeaſt as in the Southeaſt part of the Iewell, yet you muſt ſéke the aſcendent in the Northeaſt part, and not in the Southeaſt part of the Iewell, becauſe that euery degrée of any of the 6. Northerne ſignes riſeth Northernly: ſo contrariwiſe if the South part of the Zodiaque containing the ſixe Southerne ſignes doe cut the Horizon, aſwell in the Northeaſt part as in the Southeaſt part of the Iewel, yet you muſt ſéke the aſcendent in the Southeaſt part, and not in the Northeaſt part of the Iewell. As for example, the ſecond day of Auguſt 1592. the ſun being in the 20. of Leo, I would know the aſcendent at foure of the clocke in the afternoone: heere hauing laid the label to that houre, & brought the place of the ſun to the Fiducciall line thereof, I finde that the 13. degrée 30. of Aquarius doth cut the Horizon ſeruing to your latitude 52. in the Northeaſt part of the Iewell, and that the 19. of Sagittarius cutteth the ſaid Horizon in the Southeaſt part of the Iewell, which muſt be the aſcendent, becauſe that euery degrée of any of the ſoutherne ſignes riſeth Southernly, and not Northernly.

How to find the Circles of poſition, & to know how much the pole is eleuated aboue euery ſuch Circle in any Latitude, without the knowledge whereof you can not finde out the twelue houſes by this Aſtrolabe.

Propoſition. 31.

FIrſt bring the Zenith of the Rete to your Latitude, ſo ſhal the Azimuthes become circles of poſition, then vpon the Parallel of declination of the point giuen, according as the declination therof is north or ſouth: count from the limbe on your right hand, the number of ꝑ houres giuen:



But the difficultie of finding out the true aſcendent conſiſteth in knowing whether it is to be ſought in the Northeaſt quarter, or in the Southeaſt quarter of the Iewell. The Northeaſt quarter is that which lyeth betwixt Imum cœli, and the North Pole or Eaſt end of ẏ Axletree, becauſe in this caſe the axletree ſignifieth the line of Eaſt and Weſt, and the Equinoctial ſignifieth the line of South and North, at the South ende whereof is faſtened the ringle or handle. But in the former example you may plainely ſee that the North part of the Zodiaque of the Rete doth cut the Horizon, as well in the Northeaſt quarter as in the Southeaſt quarter with two ſeuerall degrees & ſignes, for in the Northeaſt quarter the Zodiaque cutteth the Horizon with ẏ firſt of Cancer which is the aſcendent, and in the Southeaſt quarter it cutteth the Horizon with the eight of Taurus, which is not the aſcendent: for you haue to vnderſtand that euery degree of the Zodiaque doth both riſe and ſet either towards the North or towards the ſouth, the firſt point of Aries and of Libra onely excepted, both which do riſe right Eaſt, and goe downe right Weſt, euen as the Equi-

noctiall

noctiall doth, whereof M. Blagraue doth gather a rule how to find out by his Iewell when the ascendent is to be sought either in the Northeast quarter of the Water, or in the Southeast quarter, which is thus: The ascention of any of the sixe Northerne signes is to be sought for in the Northeast part of the Iewell, & the ascention of any of the sixe Southern signes is to be sought for in the Southeast part of the Iewell. For although that the North part of the Zodiaque of the Rete containing the 6. Northern signes cutteth the Horizon answerable to your Latitude, aswel in the Northeast as in the Southeast part of the Iewell, yet you must seeke the ascendent in the Northeast part, and not in the Southeast part of the Iewell, because that euery degree of any of the 6. Northerne signes riseth Northernly: so contrariwise if the South part of the Zodiaque containing the sixe Southerne signes doe cut the Horizon, aswell in the Northeast part as in the Southeast part of the Iewel, yet you must seeke the ascendent in the Southeast part, and not in the Northeast part of the Iewell. As for example, the second day of August 1592. the sun being in the 20. of Leo, I would know the ascendent at foure of the clocke in the afternoone: heere hauing laid the label to that houre, & brought the place of the sun to the Fiducciall line thereof, I finde that the 13. degree 30. of Aquarius doth cut the Horizon seruing to your latitude 52. in the Northeast part of the Iewell, and that the 19. of Sagittarius cutteth the said Horizon in the Southeast part of the Iewell, which must be the ascendent, because that euery degree of any of the southerne signes riseth Southernly, and not Northernly.

How to find the Circles of position, & to know how much the pole is eleuated aboue euery such Circle in any Latitude, without the knowledge whereof you can not finde out the twelue houses by this Astrolabe.

Proposition. 31.

FIrst bring the Zenith of the Rete to your Latitude, so shal the Azimuthes become circles of position, then vpon the Parallel of declination of the point giuen, according as the declination therof is north or south: count from the limbe on your right hand, the number of ꝑ houres

giuen

giuen amongst the Meridians in the Mater, & the Azimuth which the Meridian of that houre cutteth shall be the Circle of position, which had, you shall finde the eleuation of the pole aboue the Circle of position thus: Count your Latitude amongst the Almicanteraths from the Zenith vpon the Circle of position found, and to that point whereas your Latitude endeth, bring the Fiducial line of the label, & reckon vpō the label how many degrées are cōtained betwixt the limbe of the Rete & that point, for the number of those degrées is the eleuation of the Pole aboue the Circle of position. As for example vsed by M. Blagraue himselfe, the 12. of October 1580. the Sun being then in the 29. degré 1′0. of Libra, and his South declination 11. deg. 1′0. I would know at 8. of the clock at night in what Circle of position the sunne at that time was, here I bring the Zenith to the Latitude of Reading, which is 51. deg 4′0. then for 8. of the clocke I count 8. houres amongst the Meridians in the Mater, from the South part of the Iewell vpon the Parallell of the sunne being then 11. deg. 3′0. and by attributing to euery houre 15. Meridians, I find that the Meridian whereas the 3. houre endeth doth crosse the 28. & ½. Azimuth, counting the Azimuths from the Zenith line, and that is the Circle of position wherin the sun was then vnder the earth in ꝑ Northeast quarter. Now to know how much the Pole is eleuated aboue that Circle of position, I do count from the Zenith the foresaid latitude 51 degrées, 4′0. vppon the said Circle of position, and to the point where that Latitude endeth I bring the labell, & counting theron from the limbe of the Rete the degrées contained betwixt the said limbe, and the foresaid point. I find the number of them to be 43. degrees 3′0. wherfore I conclude that the Pole is eleuated aboue the said Circle of position 43. degrées 3′0.

How to find out all the 12. houses of heauen, and therby to erect a figure at any houre of the day or night.

Proposition. 32.

YOu shall vnderstande the order of this better by this one example giuen by M. Blagraue himselfe, then by manifold rules which be also so plainly expressed and obserued in this example, as you neede none other in-

struction

ſtruction to erect the like figure in any Latitude, and at any houre of the day or night. Suppoſe then that you would erect a figure for one that was borne the twelfth of October 1580. at eight of the clock at night in the Latitude 51.40. the ſunne being then in the 28. degree 1'0. of Libra, and his declination being at that time 11. degrees 1'0. Southward: Here firſt ſet downe in your figure already drawne the foure Angles before found by the 30. Propoſition anſwerable to the ſaid day and houre, then to finde out the reſt of the houſes doe thus, bring the Zenith of the Rete to the latitude preſuppoſed, which is 51. degrees 4'0. and ſtaying it there, marke what number of Azimuthes or Circles of poſition doth cut euery 30. degree of the Equinoctiall, counting the degrees of the Equinoctiall by helpe of the Meridians from the limbe towards the Centre, but you muſt count the number of the Azimuthes or Circles of poſition from the Zenith line towardes the limbe, of which Circles of poſition ther be no more but fiue at the moſt (that is to ſay) three betwixt the limbe and the Centre on the one ſide, and as many on the other ſide of the Centre, the eleuation or rather depreſſion of euery one whereof you muſt ſeeke to know by the laſt Propoſition. But M. Blagraue ſaith that you néede to know the eleuation or rather depreſſion, but onely of two Circles of poſition, that is of that which ſheweth the eleuenth and third houſe, and of that which ſheweth the twelfth & ſecond houſe, and ſo ſayth Stadius alſo in the beginning of his Ephemerides, treating of the 12. houſes, for hauing them you haue all the reſt. The order of working according to M. Blagraue his rule is thus: hauing brought the Zenith to the foreſaid Latitude, looke what Circle of poſition cutteth the Equinoctial in the firſt 30. degrees next to the limbe, and you ſhall finde that the 47. Azimuth or Circle of poſition (counting from the Zenith line) cutteth that point of the Equinoctiall, and therewith ſerueth to the eleuenth houſe, and alſo to the third houſe, and the eleuation of this Circle is 32. degrees, then from thence tell vpon the Equinoctiall 30 degrees more, which doe make in all 60. degrees, and through that point you ſhall find the 19. Azimuth or Circle of poſition to paſſe, whoſe eleuation is 47. degrees and this Circle ſerueth to the 12. houſe and to the ſecond houſe. Now keeping wel in mind thoſe two laſt

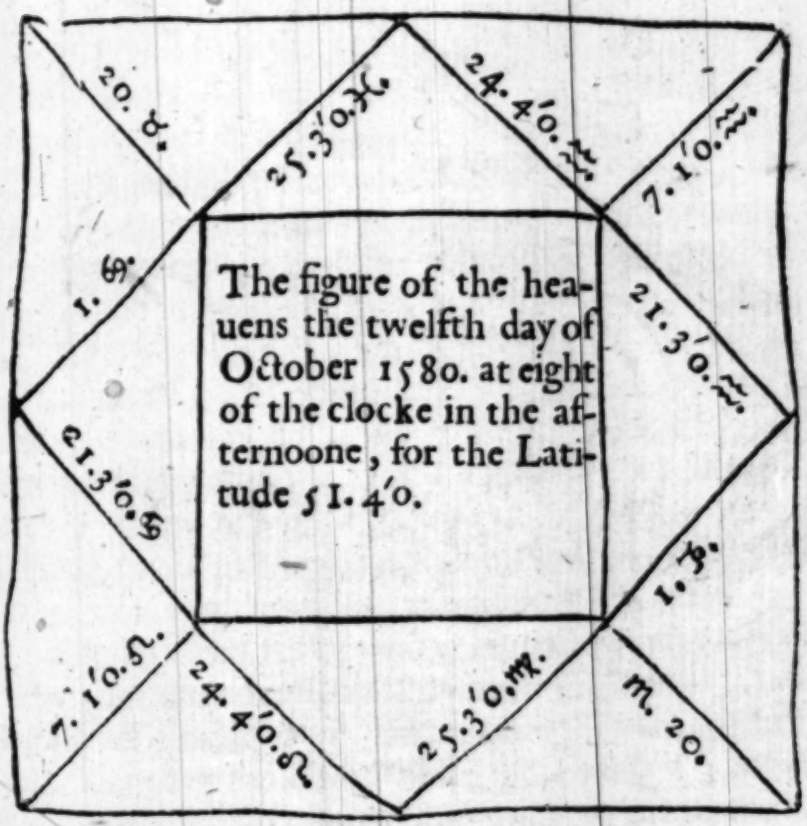
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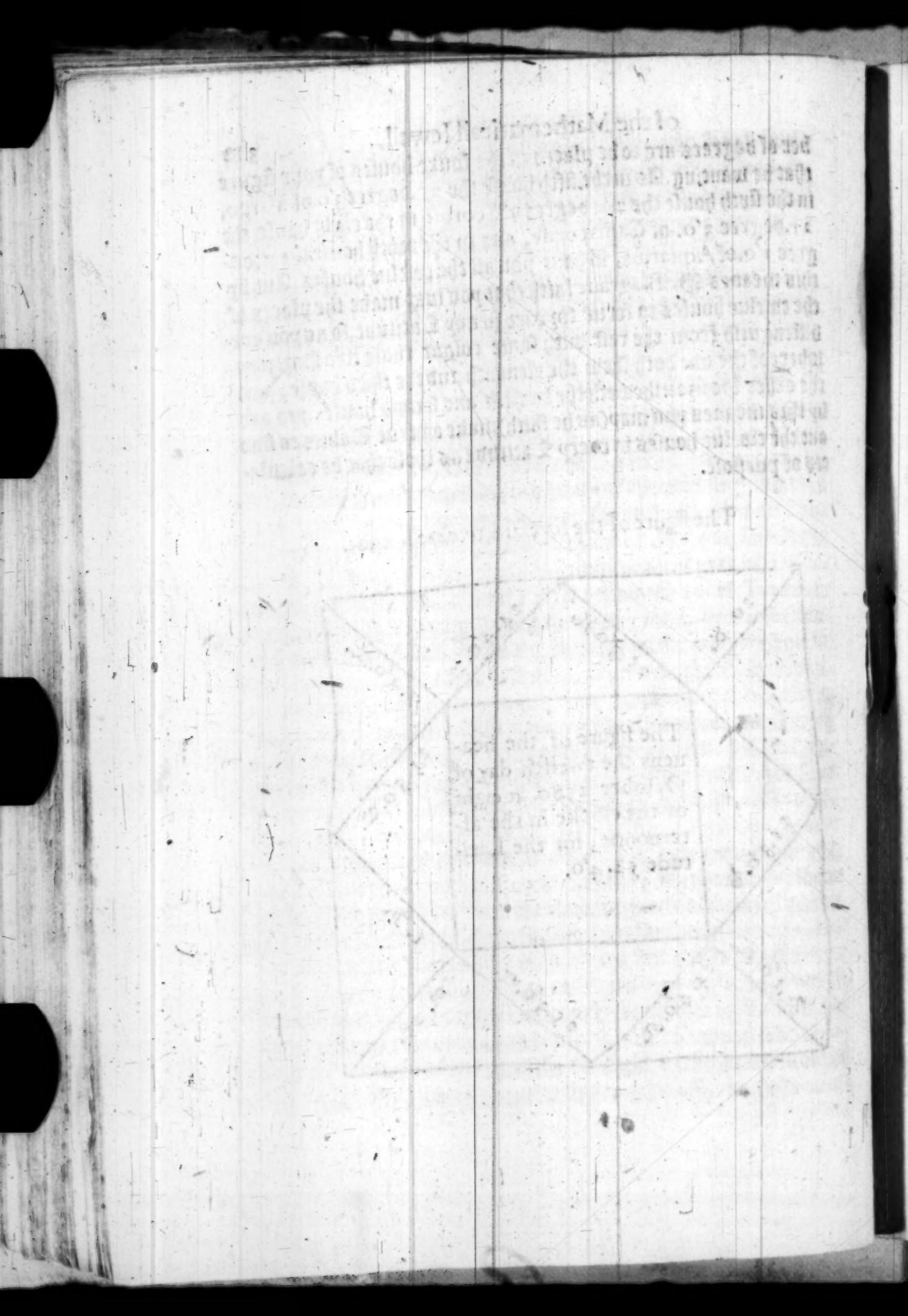
eleuations, that is, 47. and 32. worke thus: Lay your labell to the eight houre of the morning, which is 30. degrées distant from the right Horizon or Arlettee, and bring to the Fiduciall line thereof the Culmen cœli or 10. house first set downe in your figure which is the 24. of Aquarius, and staying it there, looke what degree of the Ecliptique cutteth the 32. Horizon which serueth to the 11. house counting from the right Horizon towards your left hande. And by following that Horizon vp towards the North pole, you shall finde that the 25. degree 30. of Pisces cutteth the same Horizon very nigh vnto the Pole, but by my instrument I find it to be the 27. degree of Pisces, which perhaps is not truely made, and therefore set downe in the eleuenth house of your figure 25. degrées 30. of Pisces. Then bring the foresaid Culmen cœli together with the labell to the tenth houre of the morning, which is 30. degrées further towards the South, and staying it there, looke what degree of the Ecliptique cutteth the 47. Horizon, seruing to the twelfth house, and you shall find that the 20. degree of Taurus cutteth that Horizon, wherefore set downe the 20. of Taurus in the twelfth house of your figure, then bring the Culmen cœli together with the labell to the 12. houre at noone, and you shall see the ascendent which is the first of Cancer to cut the oblique Horizon, which is 51. degrées 40. and from thence bring the label and culmen cœli to two of the clocke in the afternoone, and staying it there you shall see the 21. degree of Cancer to cut the 47. Horizon which sheweth the second house and also the twelfth house as before, wherefore set downe 21. of Cancer in the second house of your figure, that done, remoue the labell together with Culmen cœli to foure of the clocke in the afternoone, and there staying it, you shall see the seuenth of Leo to cut the 32. Horizon which sheweth both the third house and the eleuenth house as before, wherefore set the seuenth of Leo in the third house of your figur, so haue you eight of the houses, that is to say, the first, the second, the third the fourth, the seuenth, the tenth called culmen cœli, the eleuenth and the twelfth, so as there want onely foure, that is, the fifth, the sixth, the eight and the ninth house. The fift is opposite to the eleuenth, the sixth to the twelfth, the eight to the second, and the ninth to the third, whose opposite signes eche one hauing like num-

ber

ber of degrees are to be placed in the foure houses of your figure that be wanting. As in the fifth house the 25. degree 30. of Virgo, in the sixth house the 20. degree of Scorpio in the eight house the 21. degree 30. of Capricorne, and in the ninth house the 7. degree 10. of Aquarius, so haue you all the twelue houses. And by this meanes M. Blagraue saith that you may make the places of the twelue houses to serue for euer in any Latitude, so as you doe distinguish from the rest with some colour those two Horizons, whereof the one doth shew the eleuenth and the third house, and the other Horizon sheweth the twelfth and second house, yea and by this meanes you may (as he saith) make as true Tables to find out the twelue houses in euery Latitude as those that be calculated of purpose.

The figure of the foresaid twelue houses.



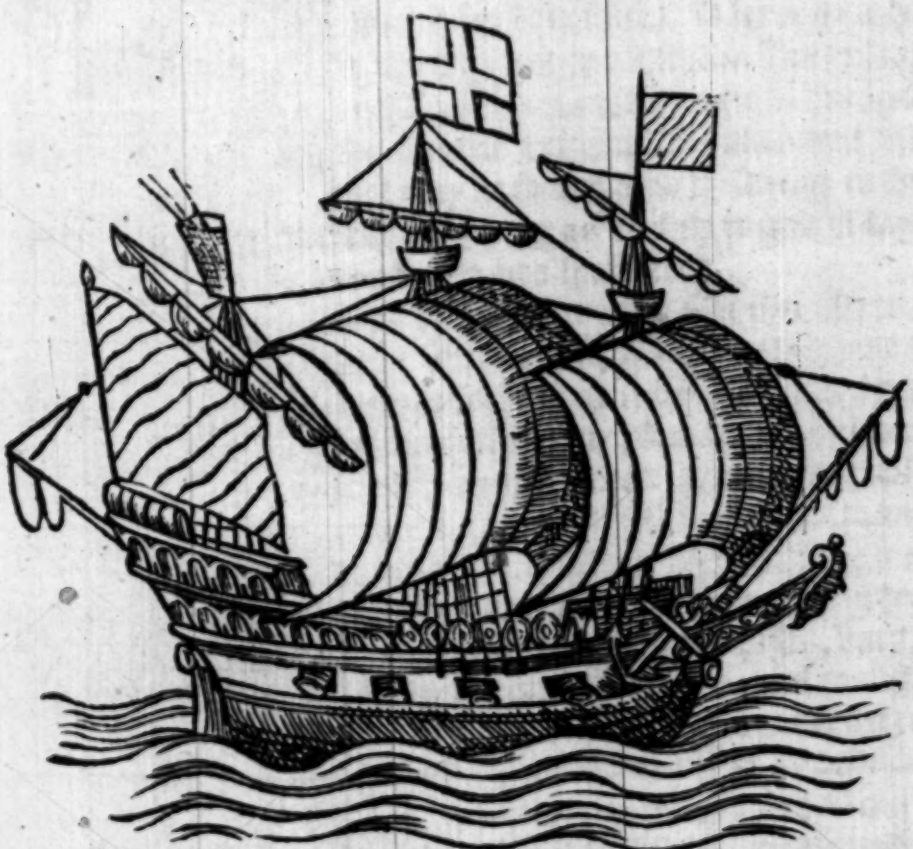


A newv and neceſſarie Treatiſe of Nauigation con-

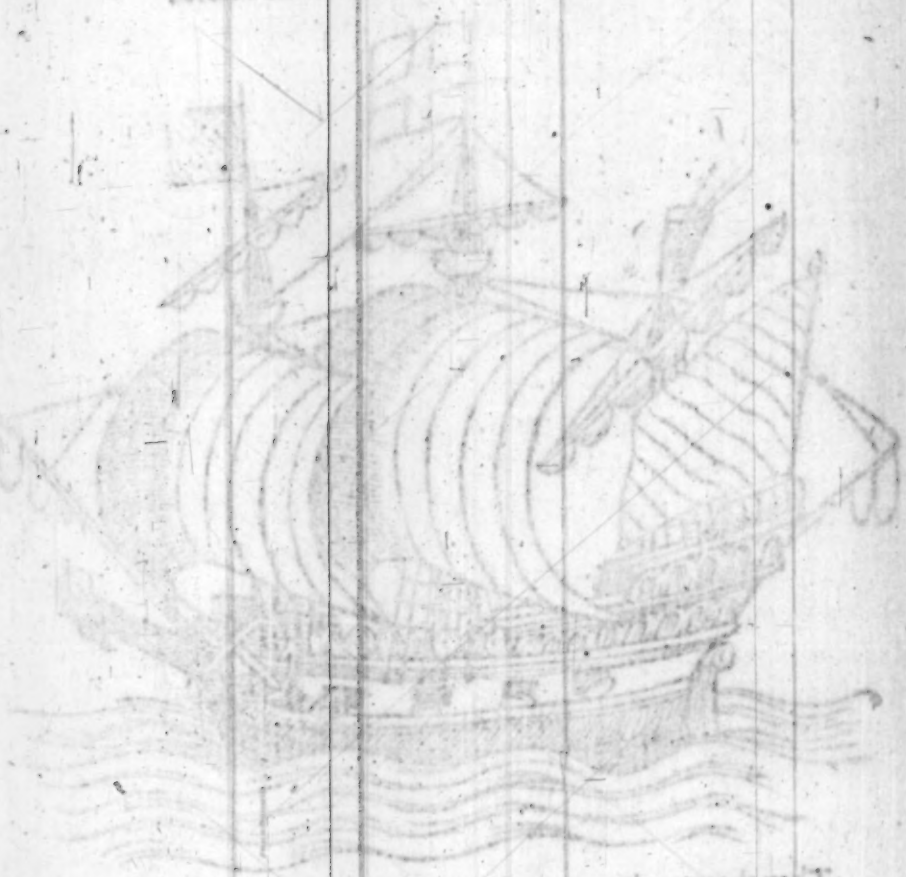
taining all the chiefeſt principles of that Arte.

Lately collected out of the beſt Mo-

derne writers thereof by M. Blundeuile, and by him reduced into ſuch a plaine and orderly forme of teaching as euery man of a meane capacitie may eaſily vnderſtand the ſame:



They that goe downe to the Sea in ſhips, and occupie their buſineſſe in great waters: Theſe men ſee the workes of the Lord and his wonders in the deepe. Pſalme. 107.



Of Nauigation, what it is, and with what order the principles therof are here taught by Maſter Blundeuill, according to the rules of the beſt moderne writers of that Arte.

NAVIGATION is an Arte which teacheth by true and infallible rules, how to gouerne and direct a ſhip from one port to another ſafely, rightly, and in ſhorteſt time: I ſay here ſafely, ſo farre as it lyeth in mans power to performe. And in ſaying rightly, I meane not by a right line, but by the ſhorteſt and moſt commodious waye that may be found: And by ſaying in ſhorteſt time, I meane thereby according as the ſhip is good of ſayle, and according as both winde and tide ſhall ſerue.

The meanes to attaine to this Arte as to all other Artes are two partes, whereof euery Arte conſiſteth, that is Methode and Practiſe, which is as much to ſay here as inſtruction and experience: For of the chiefe points of this Arte, ſome are to be learned by inſtruction, and ſome onely by experience: for what inſtruction I pray you will ſerue to make a good coaſter, that is to ſay, to know any Cape or Cliffe when he ſeeth it, vnleſſe he hath firſt ſéene it and hath before taken good markes thereof. Alſo to know the currents in all places, the deapth and qualities of waters, ſands, flats, or ſhoulds, and ſuch like, the perfect knowledge whereof conſiſteth chiefely in experience. Of which experience I minde not heere to treate, becauſe I knowe that a Dutchman called Wagoner or Aurigarius hath lately written of theſe things notably wel & eſpecially for theſe our ſeas and the Northeaſt ſeas, whoſe booke I doubt not but that ſome of our learned ſea men will ſet forth in

our mother tongue, with some augmentation of their owne experience for the East and West Indies, for the profite of their countrie and to their owne praise & commendation. In the meane time I will proceede with instruction, the chiefe pointes whereof are these here following: first to know the vses of such instrumentes as euery skilfull sea man ought to haue with him that mindeth to sayle any long voyage, which are these heere following: First a perfect Kalender or Ephemerides, the Mariners ring or Astrolabe, the Crosse-staffe called of the Spaniardes Balla stella, the two Globes both Celestiall and Terrestriall: Of al which things I haue in a manner already written seuerall Treatises. Item an vniuersall Horologe, to knowe thereby the houre of the daye in euery Latitude, and a Nocturnlabe to know thereby the houre of the night. And it were necessarie for him that sayleth long voiages to carry with him a Topographicall instrument to describe therby those straunge Coasts & Countries wherby he sayleth, the vse of which instrument is plainely taught by William Borne in his booke called the Treasure of Trauailers, and by Maister Digges in his booke called the Pantometria, wherefore I shall not nede to speake any further thereof: Also the Mariners compasse whereof I do not only make a plaine description and shewe the vses thereof, but also how to finde out the variation of the same, according to the precepts of the best moderne writers therof. And lastly the Mariners Carde, whereof whilest I speake, I doe not onely shewe the making thereof, and how to drawe the Parallels in better sort then they are vsed to be drawne in the common Cardes, but I set downe therewith the chiefest vses of the Card, amongst which is taught how to know by help of the Card and certaine Tables made of purpose, what way your ship hath made in sayling by any rombe or wind yea in sailing right East, & West, which heretofore (as Cognet sayth) hath beene thought a thing vnpossible to be knowne, but only by coniecture: And being out of your way how to know in what place you are, & to mark the same in your Card that you may the more readily direct your ship againe to the place whereunto you would go. But al these instruments serue to little purpose, vnlesse you know also the North star with his guards, & diuers other starres situated aswel towards the

North

North as towardes the South pole, together with their Longitudes, Latitudes, declinations, and greatnesse, to know thereby the Latitude of any place, & the houre of the night: also the course of the sunne and his declination, by helpe whereof you may know the Latitude of any place, the times and seasons of the yeare, the houre of the day, and the length of the day and night in euery latitude. And finally you must know the course of the Moone, whereon dependeth the knowledge of the tides in all places: Of all which things I mind here to treat in such order as the Chapters hereafter following do shew.

A generall Kalender or Almanacke for euer, contayning these 9. Chapters next following.

How to find out the golden number euery yeare. Chap. 1.

How to find out the Epact in euery yeare. Chap. 2.

How to knowe the Epact by the Mariners rule vpon your thombe. Chap. 3.

Howe to knowe the age of the Moone in euery moneth throughout the yeare. Chap. 4.

How to know the change, ful, and 4. quarters of the *Moon*, euery moneth throughout the yeare. *Chap.* 5.

How to know in what signe and degree the moone is euery day throughout the yeare. Chap. 6.

How to finde out the moueable feasts euery yeare, onely by knowing the day of coniunction in the moneth of Februarie. Chap. 7.

How to finde out the circle of the Sunne, called in Latine *Circlus Solaris*, and thereby the Dominicall Letter in euerie yeare. Chap. 8.

How to find out the number of indiction. Chap. 9.

A briefe description together with the vse of the Diurnall

Table or Almanacke of *Iohannes Stadius*. Chap. 10.

How to find out the place of any Planet by the Ephemerides, Chap, 11.

Of the Mariners Ring or Aſtrolabe, and of his croſſe ſtaffe, Chap. 12.

A briefe deſcription of M. *Hood* his croſſe ſtaffe, and of all the partes thereof. Chap. 13.

How to ſet the partes of M. *Hoods* ſtaffe together to ſerue ſuch Aſtronomicall vſes as do chiefly belong to the Mariner. Chap. 14.

The ſhape or figure of the foreſaide ſtaffe, hauing all his partes ſet together to ſerue for Aſtronomicall vſes, Chap. 15.

How to take the altitude of the Sunne at any houre that he is to be ſeene with the eye by M. *Hoods* ſtaffe. Chapter 16.

How to take the altitude of any Star with M. *Hoods* ſtaffe. Chap. 17.

How to take the diſtance betwixt two ſtars with *M. Hoods* ſtaffe. Chap. 18.

Of the *M*ariners Aſtrolabe. Chap. 19.

A briefe deſcription of the Mariners Aſtrolabe, & the vſe thereof. Chap, 20.

A briefe deſcription of the Mariners croſſe ſtaffe. Chap, 21.

The vſes of the *M*ariners croſſe ſtaffe. Chap. 22.

Of the wind, what it is, and of the diuers kindes and names thereof. Chap, 23.

A briefe deſcription of the Mariners Compaſſe, and vſe thereof. Chap, 24.

Of the Lodeſtone, and of the variation of the Compaſſe in Northeaſting and Northweſting. Chap. 25.

How to find out the variation of the compaſſe in euery latitude. chap. 26.

Of the Mariners Card, and of the making thereof. chap. 27

The ſhape & figure of the firſt lineaments of the *M*ariners Carde drawne after the old manner, and how to ſet downe the places of the lande or ſea therein, chap. 28

A Table to draw therby the Parallels in the Mariners card, together with the vſe thereof in truer ſorte then they haue beene.

beene drawne heretofore. Chap. 27.

The draught of the *Meridians* and *Parallels* of the Mariners *Carde* or nauticall Planiſpheare according to the former table. *Chap.* 30.

The foure chiefeſt vſes of the *Mariners Card. Chap.* 31.

How to know the way of your ſhip, and how many leagues are to be accounted for one degree of Latitude in euery rombe whereby you ſayle. Chap. 32.

How to account the leagues in ſayling directly Eaſt or weſt without changing latitude or altitude of the Pole. Chap. 33.

A Table to helpe you to know what way your ſhippe hath made in ſayling right Eaſt or Weſt without chaunging your latitude, together with a briefe deſcription and vſe thereof. Chap. 34.

An example of counting the way of your ſhippe in ſayling right Weſt. chap. 35.

An other example of counting the way of your ſhip in ſayling right Eaſt. chap. 36.

To know how much you goe out of your way in ſayling by one wrong rombe or by more. 37.

Of the North Starre, otherwiſe called the Lodeſtarre, and of his guardes, and how to know the ſame. chap. 38.

The vſes of the North ſtarre and of his guardes. chap. 39.

To know by helpe of a little Table made according to the Mariners rule touching the 8. principall rombs, ſhewing how much and when the Lodeſtarre is either aboue or beneath the Pole, that you may knowe thereby the true altitude of the Pole in taking the height of the Lodeſtarre with your Aſtrolabe or croſſe ſtaffe. chap. 40.

How to make an Inſtrument which will ſhewe at any houre of the night how much the *Lodeſtarre* is either aboue or beneath the Pole in euery other rombe as wel as in the 8. principall rombes, and alſo the true houre of the night. chap. 41.

How to know by the foreſaid twofold inſtrument as wel the mounting and deſcending of the North ſtar as the true houre of the night both at one inſtant and alſo the eleuation of the Pole. chap. 42.

What ſtars are to be obſerued by thoſe that ſayle beyonde the Equinoctiall vnder the South Pole. Chap. 43.

Of the Sunne, and of his motion, and of the chiefeſt apparances belonging to him. Chap. 44.

A Table ſhewing the declination of the Sunne euery day throughout the yeare, and the vſe thereof. Chap. 45.

Of the foure ſeaſons of the yeare, that is, Spring time, Summer, fall of the leafe, called otherwiſe Autumne, and winter. Chap. 46.

How to knowe when the Sunne riſeth and ſetteth in euery latitude, and thereby the length of the day and night, and alſo in what rombe or wind he riſeth and ſetteth, and how much he declyneth euery day from the Equinoctiall either Northward or Southwarde. Alſo how to know the eleuation of the Pole, otherwiſe called the latitude of any place, by knowing the Meridian Altitude of the Sun, & his declination. Chap. 47.

Of the ſhaddow of the Sunne, and how to know therby the houre of the day in any latitude by help of an vniuerſall diall. Chap. 48.

Of the *Moone* and of all her diuers motions. Chap. 49.

How to know in what ſigne the point *Auge* of the Moone is in any yeare. Chap. 50.

When the Moon is ſaid to be in Coniunction with the Sun, or to be at the ful, and what her greateſt latitude is aſwel from the Ecliptique line, as from the Equinoctiall. Chap. 51.

How to know in what part of the Zodiaque the head of the Dragon is euery yeare. Chap. 52.

How to know the tides in any place by the Moone. Chap. 53.

How to knowe by helpe of an inſtrument the tydes at any place. Chap. 54.

How a generall Rutter ſhewing the tides in all places ſhold be made. Chap. 55.

A generall Kalender or Almanacke for euer.

WHat this word Kalends signifieth, & from whence it is deriued is before set downe in the first booke of my Treatise of the Spheare the 45. chapter. But because there bee generall rules to knowe the coniunction of the Moone with the Sunne, her full, and all her foure quarters, and also the moueable feastes and Dominicall letter, and such like thinges easily to bee learned without the helpe of any particular Kalender, I thought good first to set downe this general Kalender, containing 9. propositions, as followeth.

How to finde out the Golden number euery yeare. Chapter. 1.

THe Golden number is the number of 19. proceeding from 1. to 19. and so to begin againe at 1. And it is so called because it was sent in golden letters frō Alexandria in Ægypt to Rome: For in 19. yeares the Moon doth make all her sundry motions & changes, and returneth againe to the place where she first began. And to finde the foresaid number the way is thus. Adde 1. to the yeare of the Lord whereof you inquire, and diuide the same by 19. and the remainder shalbe the Golden number for that yeare: As for example, being desirous this present yeare 1590. to knowe the Golden number, I adde 1 to the said yeare, and so make it 1591. which being diuided by 19. there remaineth 14. which is the Golden number of this present yeare.

But when there is no remainder, then 19. is the Golden number, and remember that the Golden number beginneth alwayes at the first of January, and the Epact the first of March.

How to find out the Epact in euery yeare.

Chapter. 2.

THe Epact is a number not exceeding 30. because the Moone betwixt change and change, neuer passeth 30. dayes, and thereby the common Lunar yeares consisting of twelue Moones is lesser then the Solar yeare by 11. dayes, for to euery Moone are attributed no more but 29. dayes and a half, which make in all 354. daies, so as the common Solar yeare consisting of 365. dayes excéedeth the Lunar yeare 11. dayes from whence the Epact taketh his originall, which Epact is found thus. Multiply the golden number of the yeare by 11. the product wherof if it be vnder 30. then it is the Epact. But if the product be aboue 30. then diuide the product by 30. & the remainder shalbe the Epact. As for example, to know the Epact in the year 1590. the golden number being 14. as before: here hauing multiplyed the same by 11. and diuided the product thereof by 30. I find the remainder to be 4. which is the Epact of the said year. Also by knowing one former Epact you shal haue it euer after by adding thereunto 11. and if the number doe exceéde 30. then you must diuide the same by 30. and the remainder shal be the Epact, as by adding 11. to 4. I know the Epact shall be the nexte yeare which is 1591. the number of 15. and by adding 11. to 15. the Epact in the yeare of our Lord 1592. shalbe 26. and so forth.

How to knowe the Epact by the Mariners rule vpon your thumbe.

Chap. 3.

FIrst, you must suppose the inside of your left thumbe to be diuided into three spaces, and the nethermost space to containe 10. the middle space 20. and the highest space towarde your thumbes end, to containe 30. and knowing first the golden number, begin to tell the same at the nether space saying there 1. at the middle space 2. at the third space 3. then be-

beginne againe at the lowest space, and there say 4. and so continue your account still after that manner, vntill you haue the full summe of the Golden number, and marke vppon what space the full summe falleth, for the Golden number being added to the number of that space, doth shew the Epact, so as the totall summe doth not exceed 30. for then you must subtract 30. and the remainder shalbe the Epact: as for example, in the yeare 1591. the golden number is 15. which being counted vppon your thombe in such order as is before taught, it will fall vpon the highest space, which is 30. to which if you adde the Golden number which is 15 it will make in all 45. from which summe if you subtract 30. there will remaine 15. which shall be the Epact for that yeare, so as the Epact and Golden number in that yeare are like numbers. For euery three yeares they are alwayes like, as when the Golden number is eyther 3. 6. 9. 12. 15. or 18. the Epact hath also like number.

How to knowe the age of the Moone in euery moneth throughout the yeare.

Chapter 4.

ADde to the Epact the number of monethes from the beginning of March, together with the moneth wherein you seeke, and also the number of the dayes past of that moneth, wherein you seeke, and the summe of such addition wil shew you the age of the Moone, as for example, I would know the age of the Moone the first day of December in the yeare 1590. Here knowing the Epact of that yeare to bee 4. I adde therennto the number of the monethes from the beginning of March, which are 10. monethes, and also the number of dayes of December, which are sixe, and the summe thereof is the age of the Moone, if the sum bee lesse than 30. But if the summe of such addition do exceede 30. then you must subtract 30. and the remainder shalbe the age of the Moone, so as the moneth wherein you seeke haue 31. dayes, for if it hath lesse than 31. dayes,

then

then you muſt ſubtract but 29. and the remainder ſhal be the age of the Moone, as for example, ſuppoſe you ſéke the age of the Moone the 22. of Nouember in the yeare 1589. in which year the Epact was 23. here by adding to the Epact firſt 9. Monethes, and then twentie two dayes, it maketh in all 54. out of which by ſubtracting 29. becauſe Nouember hath but 30. dayes, the remainder is 25. which was the age of the Moone in that moneth, day, and yeare.

How to know the change, the full, and foure quarters of the Moone euery moneth throughout the yeare.

Chapter. 5.

MArtin Cortes in his booke called the Art of Nauigation teacheth a rule to find the day of the change, in euery moneth by knowing the age of the Moone that day you ſeeke, and then by reckoning from that day backwarde the number of the dayes that went nexte before. or els by taking the age of the Moone out of the dayes of the moneth that went next before, as for example, the laſt of October 1592. I finde by the fourth propoſition the age of the Moone to be 5. which being taken out of 31. (for ſo many dayes October hath) there remayneth 26. which day by this meanes ſhould be the day of the chaunge, but the very day indéde was the 25. of the ſaid moneth, for the former rule to knowe the age of the Moone is not ſo true it ſelfe, but that ſometime it will fall a day eyther ouer or vnder. But Gemma Friſius teacheth to find out the day of the change in euery moneth thus. Adde to the Epact the number of the moneths from the beginning of March whereof that moneth wherein you ſéke the change, muſt be counted as one, and then ſubtract the product or ſum of that addition from 30. and the remainder will ſhewe the day of the change, which rule I finde to bee true ſo long as the ſumme of the addition doth not extéd 30. but when the ſum of the addition is more than 30. which will commonly chaunce when the Epact is a great number, as 26. or 29. he teacheth no rule for that, wherefore I thinke it beſt to take ſuch ſumme out of 59. and the remainder

mainder shall bee the day of change, or at the most but one day ouer or vnder, and hauing the day of the change, you shall haue the day of the full by adding 15. daies more to the day of change: And hauing the change and the full, you shall easily haue all her foure quarters by adding or subtracting 7. daies.

How to know in what signe and degree the Moone is euery day throughout the yeare.

Chapter. 6.

SOme doe set downe rules to knowe in what signe and degrée the Moone is euerie day, but such as are not true. And to say the truth, the Moon hath so many diuers motions as it cannot be done but by speciall Tables calculated of purpose. And by what rule soeuer you worke you must first know the place of the Sunne, which the Ephemerides most truely sheweth, and in looking for that, you shall also finde hard by it the place of the Moone, that is to say, in what signe and degrée shee is euerye day, and so orderly the place of any other Planet, and therefore I leaue to speake any further thereof.

How to find out the moouable Feasts euery yeare, onely by knowing the day of coniunction in the month of Februarie.

Chapter. 7.

THe way to finde out the Coniunction in euerye moneth is before taught in the fift Proposition. And hauing the day of the coniunction in Februarie, you may assure your self that the next tuesday following is alwayes Shrouetuesday, for though the Coniunction it selfe doe fall vppon a Tuesday, yet the next Tuesday after that, shall bee Shrouetuesday, and the next Sunday after that, is called Quadragesima, which is the first Sunday in Lent, and sixe weekes next after that

that is Easter day, whereunto if you adde fiue weekes more, that is to say, 35. dayes, you shall haue Rogation Sunday, and 4. dayes next after that is Ascention day, and tenne dayes next after Ascention day is Pentecoste or Whitsunday, and seuen daies next after that is Trinitie Sunday, and foure dayes next after that is the Feastiuall day called Corpus Christi. And you haue to note that the Sunday called Aduentus Domini, which we call the first Sunday in Aduent, is alwaies the fourth Sunday before Christmasse day, and the Sunday called Septuagesima is the third Sunday before Quadragesima, otherwise called the first Sunday in Lent, and betwixt Septuagesima and Quadragesima there are other two Sundaies, whereof that which is next before Quadragesima, is called Quinquagesima, and the next Sunday before that is called Sexagesima.

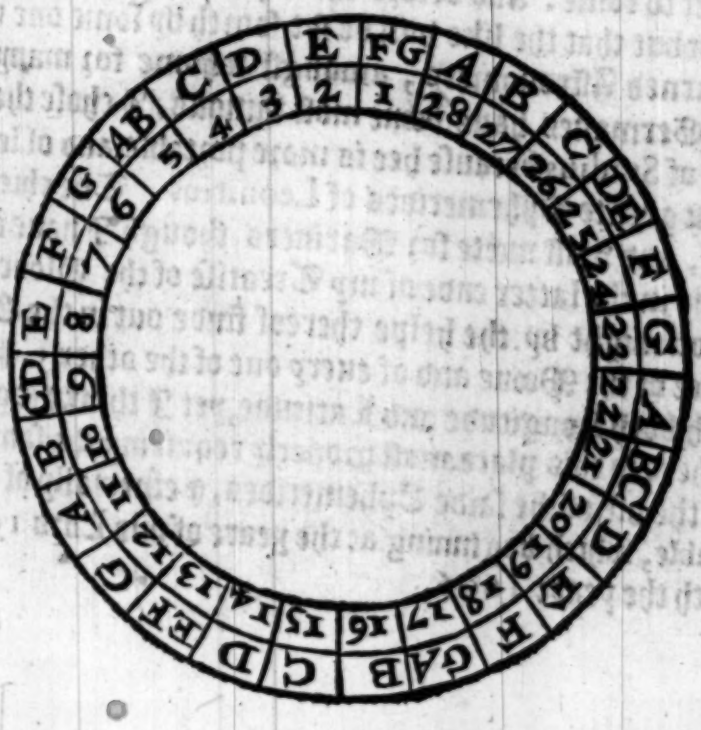
How to finde out the Circle of the Sunne called in Latine by a Greekish name *Cyclus Solaris*, and thereby the Dominicall Letter in euery yeare.

Chapter 8.

THis Circle was inuented more to finde thereby the Dominicall Letter than to shew any great changes of the Sunnes motions therein: And because there bee seuen dayes in the weeke, commonly signified by seuen letters, A. B. C. D. E. F. G. This Circle therefore is made to containe twentie eight yeres, for foure times seuen doe make twentie eight, by helpe whereof is known the true order of the letters, whereof A. signifieth alwayes the first day of euerie yeare, and for euerye leape yeare are appointed two Dominicall Letters, whereof the one continueth from the beginning of that yeare vntill Saint Mathias euen, and the other from thence to that yeares ende, as you shall more plainely perceiue by that which followeth. And first I will shew you howe to find out the iust number of the Circle of the Sunne euery yeare, which is done thus.

Adde

Adde to the peare of the Lord giuen or supposed 9. and diuide that product by 28. and the remainder shall be the number of the foresaid Circle: As for example, I would know the number of the said Circle in the peare 1590. whereunto by adding 9. I make the summe to be 1599. which being diuided by 28. there remayneth 3. Now to find out the Dominicall letter, by the number of the said Circle, you must resort to the figure following, consisting of three Circles, making two spaces, in the vpper space whereof are set downe the foresaide seuen letters, and in the nether space the numbers of the Sunnes Circle, in such sorte as euery number hath his proper Dominicall letter standing right ouer his head, and for euerie leape peare there are set downe two Dominicall Letters. All which letters are to bee counted backewarde, and not forward as they are placed in the Almanackes. As for example, hauing found the number of the Sunnes Circle for the peare 1590. to bee 3. in the lower spaee, you shall finde the letter D. standing ouer his heade, which is the Dominicall letter for that peare. And note that when 28. is the number of the Sunnes Circle A. is alwaies the Dominicall Letter, from which number you must beginne to count againe at one and so proceede backward to 28.



How to find out the number of Indiction.

Chapter. 9.



This number consisteth of 15. yeares, and is commonly set downe in all the Charters of the Bishops of Rome, and in the instruments and writings of their Pronotaries, and therefore is called Indictio Romana, wherein they seeme to follow the ancient Romans, which vsed the like indiction of years, but to other purposes, wherof I make mention in my Spheare: The way to finde out this number euery yeare is thus, Adde to the yeare of the Lord giuen 3, and deuide the product thereof by 15. and the remainder shall be the number of the said indiction. But you haue to vnderstand that this Indiction is to be counted from September, and not from March, as is the Epact.

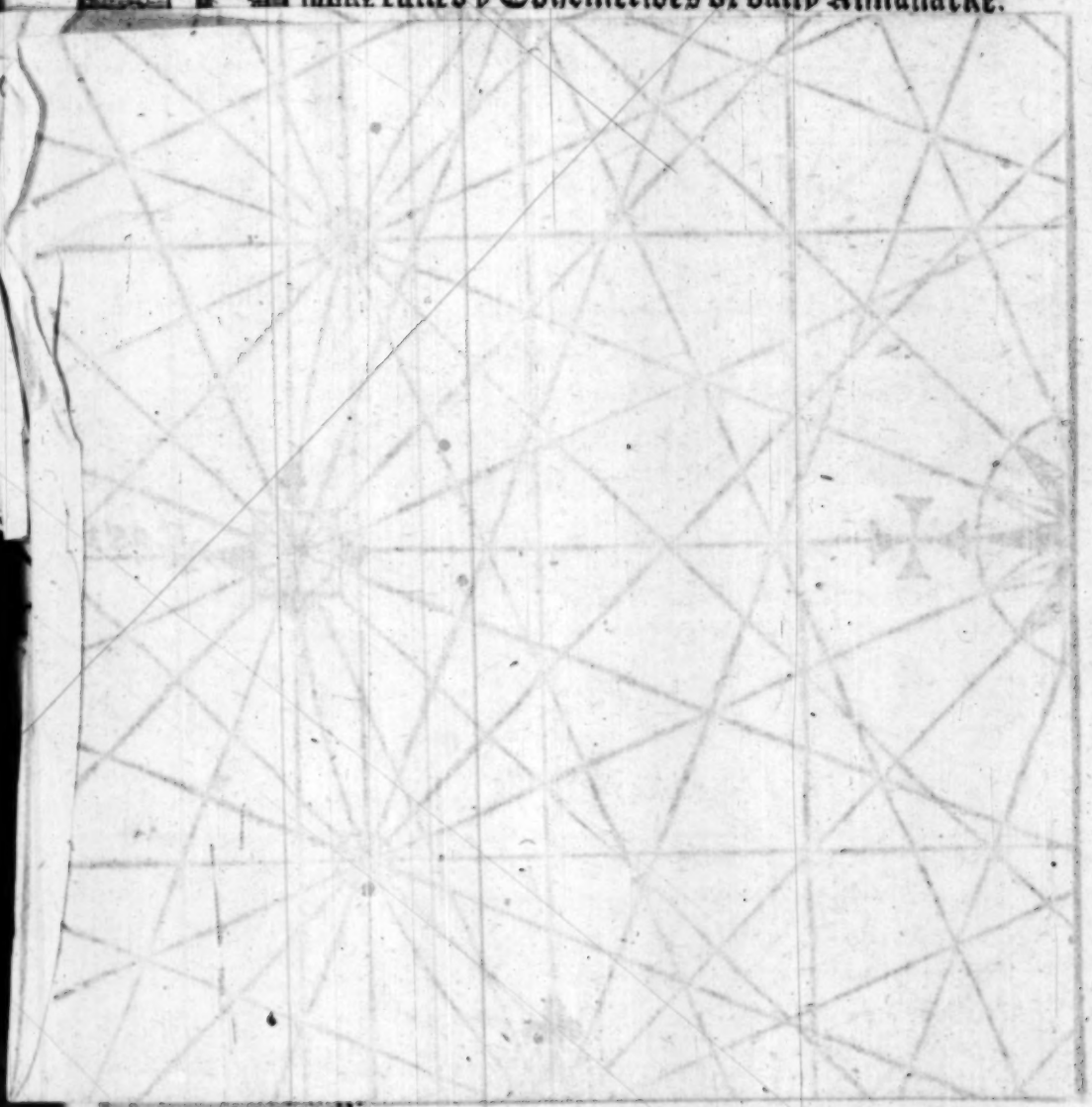
But the surest, and therewith the most generall Kalender to serue in all places is the Ephemerides or dayly Almanacke and especially that of Iohannes Stadius, which will serue for 14. yeares yet to come: And before those yeares bee all expired, I doubt not but that the like will be set foorth by some one or other of our learned Astronomers, amongst whome for many yeares past the Germanes haue béne most famous. I chose the Ephemerides of Stadius because hee is more portable, and of lesse price than that greate Ephemerides of Leouitius. The chiefest vses whereof, and most méete for Mariners, though I haue already set downe in the latter ende of my Treatise of the Globes, to the intent you might by the helpe thereof finde out in the Globe the true place of the Moone and of euery one of the other 5. Planetes that hath both Longitude and Latitude, yet I thinke it good once againe here in this place, most properly requiring the same, briefly to shew the vse of the saide Ephemerides, & especially of the diurnall Table, which beginning at the yeare of our Lord 1583. endeth with the yeare 1606.

A briefe

A briefe description together with the vſe of the diurnall Table or Almanacke of *Iohannes Stadius*.

Chapter 10.

THis Table beginneth at the 202. Page of his booke called ☿ Ephemerides or daily Almanacke.



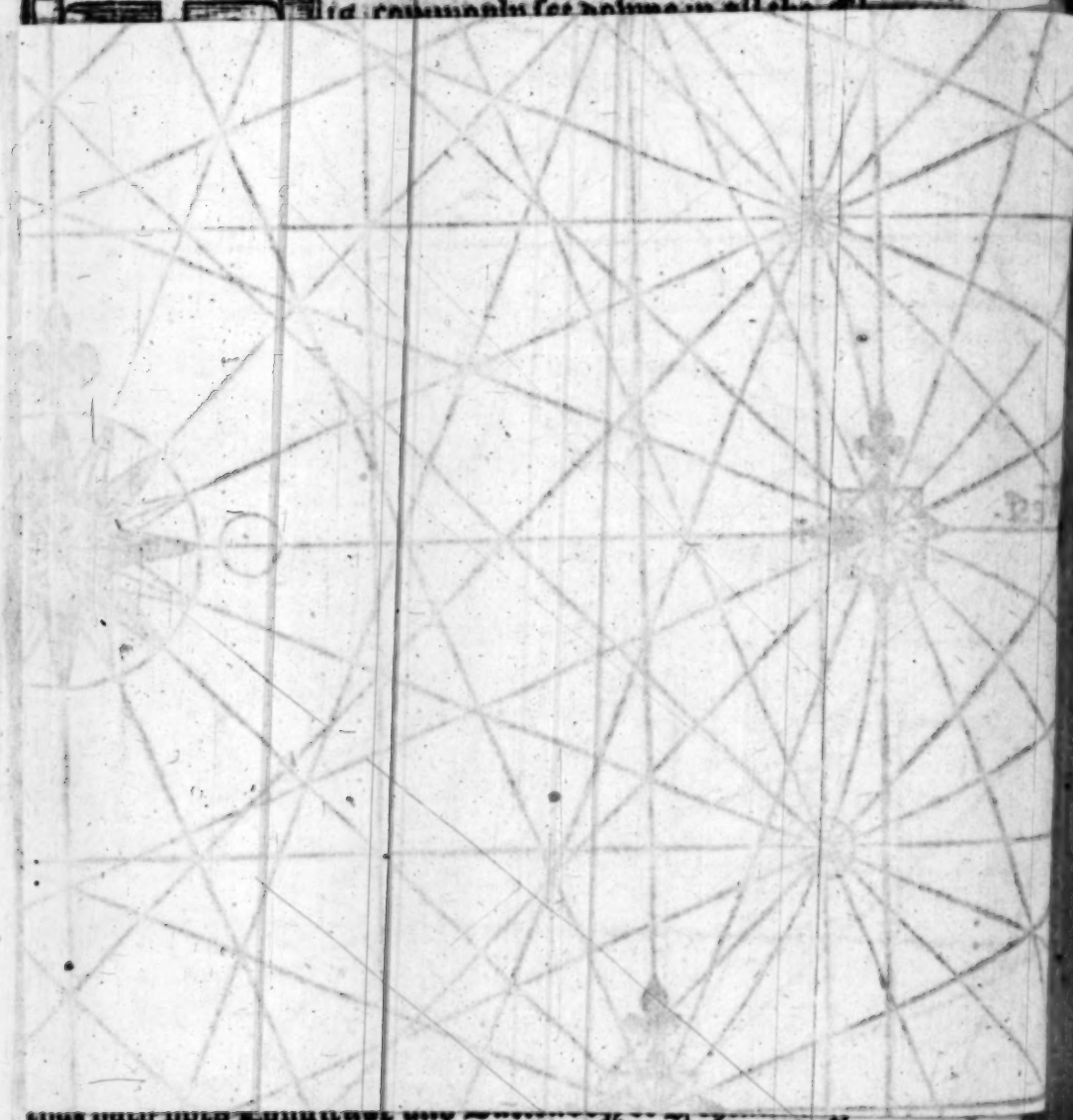
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Whereof the firſt ſignifieth a Coniunction, the ſecond an oppoſition, the third a trine aſpect, the fourth a quadrat aſpect, and the fift a ſextile aſpect.

How to find out the number of Indiction.

Chapter. 9.

This number consisteth of 15. yeares, and



that vary both Longitude and [illegible] againe here in this place, most properly requiring the same, briefly to shew the vse of the saide Ephemerides, & especially of the diurnall Table, which beginning at the yeare of our Lord 1583. endeth with the yeare 1606.

A briefe

A briefe description together with the vse of the diurnall Table or Almanacke of *Iohannes Stadius*.

Chapter 10.

THis Table beginneth at the 202. Page of his booke called ỹ Ephemerides or daily Almanacke. And euery page of the said Table that is on the left hand is diuided into 9. collums. In the first collum whereof on the left hand are set down the daies of the moneth. First, the Gregorian dayes according to the Romane account, & next to that the daies of the month according to our English account, and then in the front of euery other collum are set downe the characters, first of the Sun, and then of the other fiue Planets, that is to say, of the Moone, Saturne, Iupiter, *Mars*, Venus, Mercurie, and last of all, the heade of the Dragon figured thus ☊. And right vnder these seuen Planets, and also vnder the heade of the Dragon are set downe the signes and degrées wherein euery of these is euery day of the moneth throughout the yeare at noonetide. And in the foote of the said Table is set downe the Latitude of euery one of the fiue Planets, procéeding by the daies of the month diuided into thrée parts. And in the margent of euery left page are set downe the chiefest feasts and Saints daies that fall in euery moneth throughout the yeare.

And moreouer, in the Table on the right hande right against the left Table are set downe first the daies of the month, and then what coniunction or any other aspect the Moone hath with any of the other fiue Planets, that is, with the Sun, with Saturne, with Iupiter, with Mars, with Venus, and with Mercurie, which planets are set downe in the front of the said Table, and vnder them the Characters of such aspects as the Moone hath that day with any of the other Planets. The characters of which aspectes are these here following.

☌ ☍ △ □ ✶

Whereof the first signifieth a Coniunction, the second an opposition, the third a trine aspect, the fourth a quadrat aspect, and the fift a sextile aspect.

Two Planets are saide to bee in a coniunction when they are both in one selfe signe.

And to be in an opposition when they are in two seueral signes distant one from another, that is to say, 6. signes distant one from another.

And to bee a trine aspect when they are distant one from another by foure signes.

And to bee in a quadrat aspect when they are distant one from another by thræ signes.

And to be in a sertile aspect when they are distant but 2. signes one from another.

How to finde out the place of any Planet by the Ephemerides.

Chapter. 11.

NOw to find out ỹ place of any planet, or of the head of the Dragon by this diurnall table, you must first seeke out the day of the moneth in the first Collum of the left Table, & right against that on your right hand in the said left Table, you shal find in the common angle right vnder the Planet or Dragons head, which so euer of them you seeke, the signe and degrée wherein the saide Planet or Dragons head is the said day at noonetide.

And to find out the aspectes which the Moone hath with any of the Planets the same day, you must resort to the other Table on the right hand, obseruing like order as before.

The Example.

As for example, the 21. of Aprill 1592. which is the first of May according to the Romane accompt, I find by the Table on the left hand, the Sunne to bee in the 10. degrée, 15. minutes of Taurus, the Moon to be in the third degrée, 47. minutes of Capricorne, Saturne to bee in the 8. degrée 10. minutes of Cancer, Iupiter to be in the 18. degrée 28. minutes of Sagittarius, Mars to be in the 12. deg. 6. minutes of Gemini, Venus to be in the 2. degrée 0. minutes of Aries, and Mercurie to be in the 6. degrée 20. minutes of Taurus, and the head of the Dragon to be in the 29. degrée 45. minutes of Gemini. And right against this in the Table

on the right hand, you shall find the Moone to be in a trine aspect with the Sunne, to bee in an opposition with Saturne, to bee in a trine aspect with Mercurie.

Thus much touching generall Kalenders or Almanacks. Now as for particular Kalenders I take that which Robert Norman hath set downe in his new Attractiue to be the fittest for our countrie men, which containeth many necessarie thinges, as the contents thereof together with the Table next following the same doth shew, which Kalender I thinke it superfluous to be set downe againe here, and the rather for that I wish euery Mariner not to be without that booke, and especially containing besides the Kalender many other good preceptes touching Nauigation, to which booke is also ioyned a very learned and Mathematical discourse touching the variation of the Mariners Compasse made by Master William Borough controller of her Maiesties Nauie, who in mine opinion is one of the skilfulest men in the Art of Nauigation that is in this Realme.

Of the Mariners Ring or Astrolabe, and of his crosse staffe

Chapter. 12.

NOw according to the order set down in the beginning of this Treatise, I must needs speake somwhat of the common Mariners Ringe or Astrolabe, and of his crosse staffe which serue not to so many purposes as that of Stoflerus or of M. Blagraue before described, but onely to take the altitude of the Sunne, or of any Starre or Planet, neither are so many conclusions to bee wrought by their common crosse staffe as by that of Gemma Frisius, or by that which Master Hood hath lately inuented. Sith our Mariners for the most part doe vse their common crosse staffe to none other ende but either to take the altitude of the Sunne or of any fixed Starre or Planet, or else to take the distance betwixt two starres, the making of which staffe is plainly set downe by Martin Cortes in his Arte of Nauigation, and also the making of their Astrolabe.

But Cogniet and Wagoner do set downe a new kind of crosse

staffe, hauing 3. transames or crosses euery one longer & shorter than another by the one halfe, affirming that so many conclusions may be wrought therby as by that of Gemma Frisius, but in min opinion they are not to be cõpared in al respects to that of Gemma Frisius which though by reason that the yarde thereof is of so great a length as it is not maniable in a ship, yet vpon the land it is most seruiceable, nor yet to that of M. Hoods inuention, which is most maniable, and therewith very light of carriage, by whose staffe I thinke verily that as many things may be wrought as by any other kind of crosse staffe whatsoeuer, and with lesse trouble, yea, and in matters of Astronomie more truely by reason that the yard and transame be of one selfe length, and thereby the degrées be larger throughout the whole quadrant than they be in the common crosse staues, for in them the degrées from 50. vpwards to 90 are very smal & haue narrower spaces than M. Hoods staffe hath. Againe, whereas in vsing the Mariners crosse staffe in such Latitude, as the Sunnes beames be of great force, they are faine to haue glasses made of purpose to saue their sight, and in some places all too little. But in vsing M. Hoods staffe they shall not néd to behold the Sunne it selfe at all, but onely to marke vpon what degrée of the yarde the shadow of the Vane stréketh. Moreouer, when the Sunne or starre is 50. or 60. degrées high, they are faine to vse their Astrolabe and not their staffe, which Astrolabe in mine opinion, as I haue said before, is the best instrument of all others to take the altitude of the Sunne in the day, or of any starre in the night, and because I haue here commended vnto you M. Hoods staffe, I will first set downe a plaine description thereof together with those few Astronomicall vses which doe chiefly belong to the Mariner, without committing any offence I hope to the Author thereof, and then I will describe vnto you the Mariners ring and his common staffe together with the vses of the same.

But as I was about to describe vnto you M. Hoodes staffe, a friende of mine comming in the meane time desired mee that I would first set downe the making and vse of the crosse staffe with thrée Transames, which Wagoner and Michaell Cogniet doe so much commend, & as I heare, is vsed of many sea men in these daies, whose request I could not well denie, and therefore loe here followeth both the making and vse thereof.

Of

Of the croſſe ſtaffe hauing three Tranſames or Courſours, commonly vſed in theſe dayes, the vſe and making whereof doth hereafter follow according to the deſcription of *Wagoner* and *Michaell Cogniet*.



FIrſt prepare a right ſtaffe of firme woode that is ſquare euery way, bearing in thicknes 3. quarters of an inch, and in length three or foure foote, for which you muſt alſo prepare three tranſames or Curſours, euery one ſhorter then another by the one halfe, for the longeſt would containe in length twelue inches, the ſeconde ſixe inches, and the ſhorteſt or leaſt three inches. And euery one of theſe Tranſames or Curſours muſt be cut with a ſquare hole in the very middeſt, ſo as they may be made to run iuſt vpon the ſtaffe to and fro, theſe things being prepared, you muſt deuide three ſides of the ſtaffe into certain degrees to ſerue the three ſeuerall Curſours as followeth.

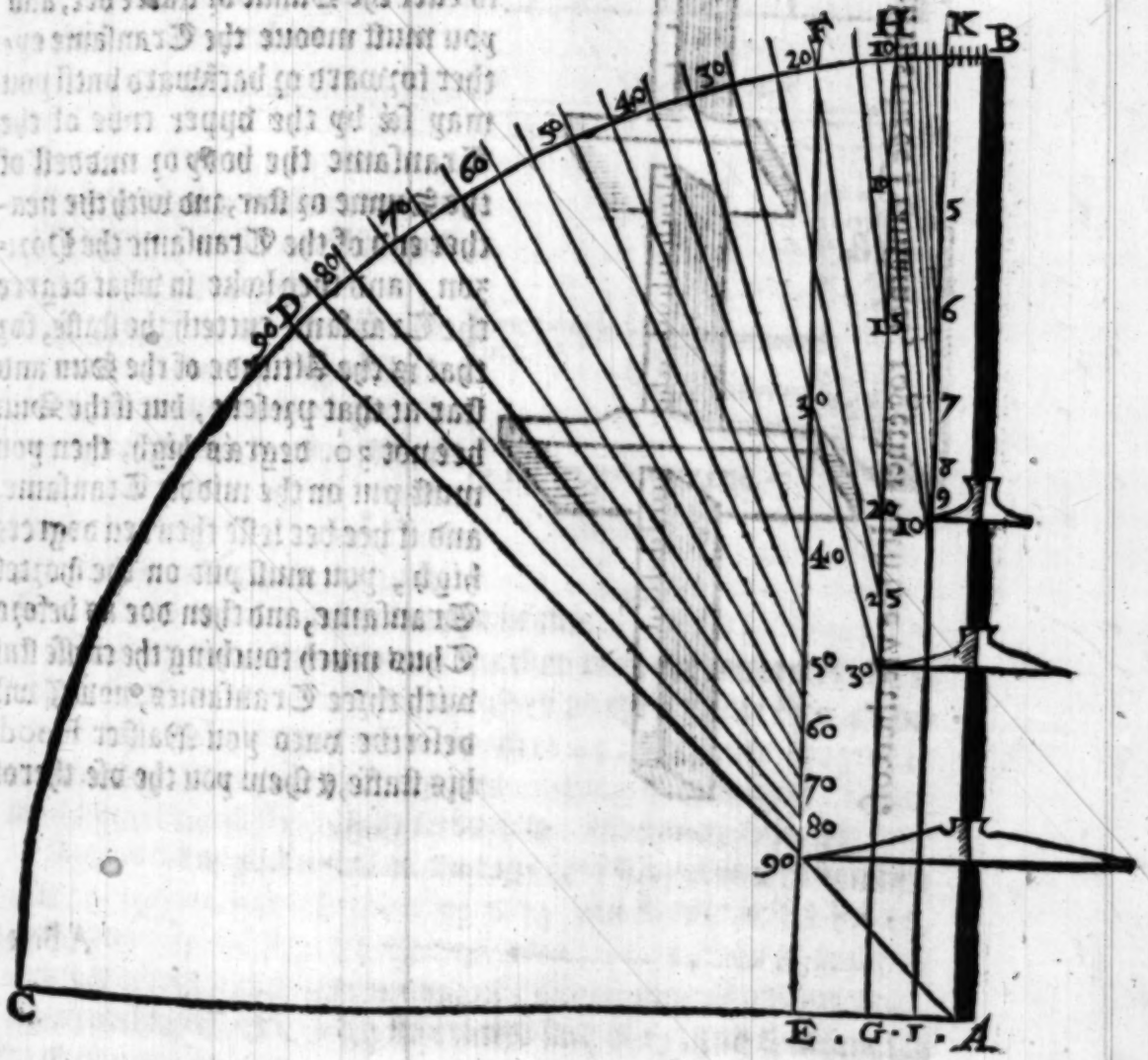
Firſt you muſt vpon a ſmooth ſquare Table ſomewhat longer euery way then the ſtaffe, and for want of one ſuch Table you may ioyne two Tables that may ſtand eauen together, drawe by helpe of a true long ſquire a right Triangle marked with the letters A. B. C. and let A. bee the right Angle, and the Centre as you ſee in the figure following, and let both the ſides of the ſaide Triangle be of like length to your ſtaffe, then putting the one foote of your Compaſſe in the Centre A. and the other foote in B. or C. drawe a quarter of a Circle from C. to B. and hauing deuided that quarter into two equall partes, make a pricke in the middeſt marked with the letter D. and laying your ruler to that pricke and to the Centre A. drawe a right line which ſhall bee A. D. then deuide the halfe Quadrant D. B. into nine equall parts making 90. equall degrees proceeding from B. to D. ſo as the firſt degree may be at B. and the 90. at D. that done, take with your Compaſſe the iuſt halfe of the longeſt Tranſame, and keeping your Compaſſe at that wideneſſe, ſet the one foote in the Centre A. and the other foote in the line A. C. ſo farre as that wideneſſe will extende, and there make a pricke marked with the letter E. then from that point drawe a right line that may bee a Pa-

rallel to the line A.B. which line shall be E.F. then take with your compasse the halfe of the middle Transame, & keeping your compasse at that wideneſſe, ſet the one foote in A. and the other foote in the line A. C. ſo farre as that wideneſſe doth extend, and there make a pricke marked with the letter G. & from that pricke draw a right line that may be a Parallel to A.B. which line ſhall be G. H. Thirdly take the one halfe of the leaſt Transame with your compaſſe and tranſferre that wideneſſe to the line A.C. ſetting the one foote of your compaſſe in A. & make a pricke with the other foote in the line A.C. as before, marked with the letter I. and from that prick draw another right line that may be a Parallel to ỹ line A.B. which ſhall be the line I. K. Now to graduate the firſt ſide of your ſtaffe to ſerue the longeſt Transame, you muſt lay the ruler to the centre A. and drawe right lines from thence to euery degrée of the circumference contained betwixt 90. and 30. and thoſe lines ſhall deuide the line E. F. into ſo many vnequall ſpaces as doe belong to the firſt ſide of the ſtaffe, for you muſt lay the firſt ſide of the ſtaffe to that line to be marked according to the diuiſion of that line, the neather ſection whereof towards the lower ende of the ſtaffe muſt bee marked with 90. and the vpper ſection with 30. ſo is the firſt ſide of your ſtaffe truely deuided to ſerue the longeſt Transame, now to ſerue the middle Transame you muſt deuide the line G.H. by drawing right lines from the Centre A. to euery degrée of the circumference contained betwixt 30. and 10. which lines will deuide the line G. H. into vnequall ſpaces, of which ſpaces the loweſt muſt be marked with 30. and the higheſt with tenne, according to which diuiſions you muſt marke the ſecond ſide of your ſtaffe by laying the ſide cloſe to the line G. H. ſo ſhall that ſide bee marked to ſerue the middle Transame, then lay your ruler againe to the Centre A. and drawe right lines to euery degrée of the circumference contained betwixt 10. and the firſt or ſecond degrée next to B. and thoſe lines ſhall deuide the line I. K. into vnequall ſpaces, the loweſt whereof is to be marked with 10. and the higheſt with 2. or 5. according as your inſtrument will beare, and according to thoſe ſections you muſt deuide the thirde ſide of your ſtaffe by laying the ſame cloſe to the ſaide line I. K. and remember to make your lines of diui-

ſion

sion so finely as is possible, so shall your staffe be the more truely graduated. And note that in graduating your staffe, you shall not nede to drawe right lines from the Centre to euery degree of the circumference contained betwixt the 90. degrée & the 60. degrée, for when the Sunne or any starre is higher then 60. degrées, you must vse your Astrolabe and not your staffe which will not serue you to look so right vp to take so great an altitude either of Sun or starre.

A figure of the foresaide Triangle.





The shape of the staffe with his three Transames, together with the vse thereof.
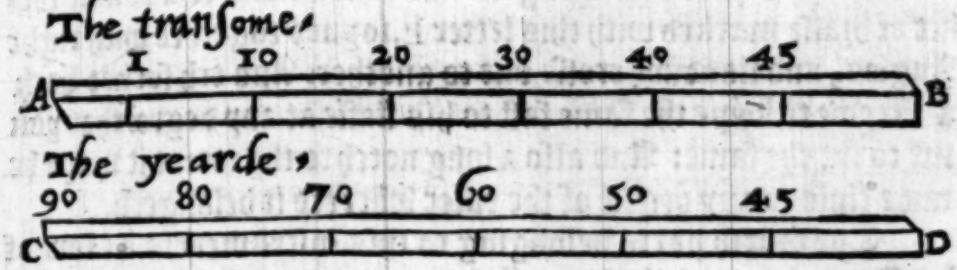
Whensoeuer you would take the Altitude of the Sunne or of anye Starre, you haue first to consider whether the Sunne or starre be 30. degrées or more high: for then you must place the longest Transame vppon your Staffe. And set the lower ende of your Staffe marked with nintie to your eye, which is alwayes to be done how high or lowe so euer the Sunne or starre bee, and you must moue the Transame eyther forward or backward vntil you may see by the vpper ende of the Transame the body or middest of the Sunne or star, and with the neather end of the Transame the Horizon, and then looke in what degree the Transame cutteth the staffe, for that is the Altitude of the Sun and star at that present, but if the Sun bee not 30. degrées high, then you must put on the middle Transame, and if hee bee lesse then ten degrees high, you must put on the shortest Transame, and then doe as before. Thus much touching the crosse staff with three Transames, now I will describe vnto you Maister Hoode his staffe, & shew you the vse therof.

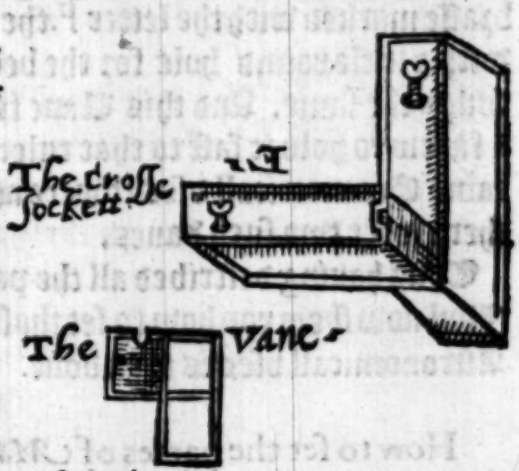
A briefe

A briefe description of Maister *Hoode* his crosse staffe, and of all the partes thereof.

Chapter. 13.

The figure or shape of euery part of the said staffe.





This instrument as you see consisteth of foure parts. First of 2. square rulers ech one bearing in thicknesse three quarters of an inch or there abouts euerye waye square, and in length I would wish ech ruler not to containe aboue one yarde, for then in some vses they would waxe toppe heauie.

Of which two rulers the one marked with the letters A. B. is called the Transame, which is deuided on the one side into 45. degrees beginning at one and so forth to 45. And euery degree is deuided againe into sixe lesser parts making 60. minutes, for sixe times ten maketh 60. which serueth for Astronomicall vses.

And on the opposite side to that, the said Transame is deuided into 1000. equal parts beginning at 25. and so increaseth by 25. vntill you come to 1000. Euerie which 25. partes is deuided into fiue lesser partes, & euery one of those againe into fiue parts, which maketh in all 25. for fiue times fiue is 25. and this serueth for Geometricall vses.

The

The other ſquare ruler called the yarde & marked with the letters C.D. is deuided into degrées like to thoſe of the Tranſame proceeding from 45. to 90. which together with thoſe degrées that be in the firſt ſide of the Tranſame doe make vppe the number of a iuſt Quadrant to ſerue Aſtronomicall vſes. And the ſide oppoſite to that is deuided into 1000. degrées proceeding from 25. to 25. like in al reſpects vnto the oppoſite ſide of the Tranſame to ſerue Geometricall vſes.

The third part belonging to this inſtrument is a double ſocket of braſſe marked with this letter E. ioyned together with right Angles, and ſtanding croſſe one to another. And ech ſocket hath a ſkrewe to kéepe the ſame faſt to his ſtaffe at any degrée that you will to ſet the ſame: And alſo a long notch to the intent it maye be laide cloſe to any degrée of the ruler whereto it belongeth.

The fourth parte belonging to this inſtrument is a Vane of braſſe marked with the letter F. the vpper edge whereof is pearced with a little round hole for the beame of the Sunne to paſſe thorough the ſame. And this Vane is made with a ſocket, and with a ſkrew to hold it faſt to that ruler whereon it is ſet. And for certaine Geometricall vſes it were neceſſarie (as ſome thinke) that there were two ſuch vanes.

Thus hauing deſcribed all the parts of the foreſaid inſtrument, I wil now ſhew you how to ſet thoſe parts together: which to ſerue Aſtronomicall vſes is thus done.

How to ſet the partes of *Maiſter Hoodes* ſtaffe together to ſerue ſuch Aſtronomicall vſes as doe chiefely belong to the Mariner.

Chapter. 14.

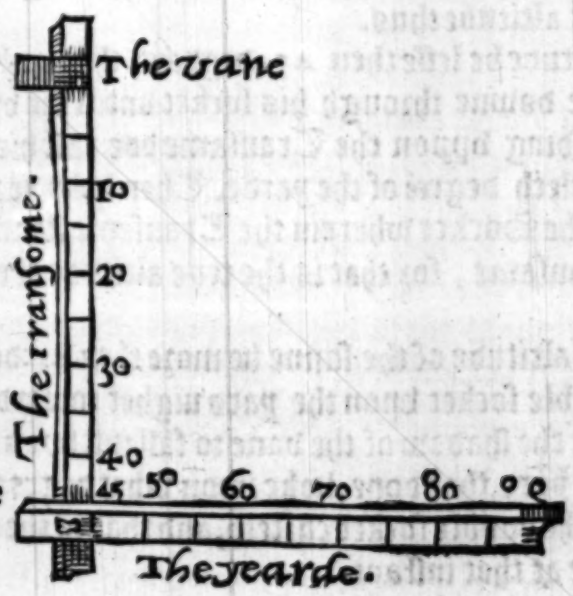
FIrſt put the neather ende of the Tranſame marked with the 45. degrée into the double ſocket, ſo as the Tranſame may ſtand right vppe, and that the notch of the ſocket may méete euen with the ſayde 45. degree, and turne the ſkrewe that the ſocket may ſtand faſt at that degree, that done put the yarde into the croſſe ſocket, ſo as the notch of the ſayde croſſe ſocket may lie iuſt vppon the 45. degree of the yarde, and there

make

make it fast by turning the skrewe: then put in the vane, which to serue Astronomicall vses must bee set at the highest ende of the Transame, in such sorte as the vpper edge of the vane pearced with the hole may stand eauen with the first point or stræke of the said Transame, & when the Transame standeth on the left hande of the yearde, then the vane must be placed on the right side of the Transame: But if the Transame doe stand on the right hand of the yard, then vane must be placed vpon the left side of the Transame: And the yard and Transame would bee so set together as the degræs of the Transame procæding downeward from one to 45. may looke towardes you, that is to saye, may stand right before your face: And the degræs of the yarde procæding from 45. to 90. would lie vpward, so as the end of the yarde marked with 90. may point to your breast or be set to your eye as occasion shall require, for such Astronomicall vses as here doe follow.

The shape or figure of the foresaide staffe, hauing all his parts set together to serue for Astronomicall vses.

Chapter. 15.



The double Socket.

How

How to take the altitude of the Sunne at any houre that he is to be seene with the eye by M. Hoods staffe.

Chap. 16.

THe Staffe being set in such order as is before taught, goe into some open place whereas you may see the Sunne, and turning the ende of the yarde marked with nunetie towards your brest, holde the yarde so leuell as you can, that it may bee a iust Parallell to the Horizon, and turne both your faces, and also the vane of the Transame towardes the Sunne. Then you haue to consider whether the sunne at that present be eyther iust 45. degrées high, or more, or else lesse then 45. degrées, which you shall easily knowe thus: For if he be iust 45. degrées high, then the shadowe of the vpper edge of the vane wil stricke iust vpon the 90. degrées of the yarde lying at your brest: But if he be more then 45. degrées high, then the shadowe of the vane will stricke short of the 90. degrée: And if it be lesse it will cast no shadow at all vpon the yarde, but stricke cleane beyond it ouer your shoulder. Nowe knowing by this meanes whether the altitude of the Sunne be more or lesse then 45. degrées, you shall take his true altitude thus.

If his altitude be lesse then 45. degrées, then make the Transame to sinke downe through his socket vntill the vpper edge of the vane standing vppon the Transame doe cast his shadow iust vpon the nintieth degrée of the yarde. Then looke at what degree the notch of the Socket wherein the Transame standeth, doth cut the said Transame, for that is the true altitude of the Sunne at that instant.

But if the altitude of the sunne be more then 45. degrées, then draw the double socket vpon the yard nigher towards your brest: vntill you see the shadow of the vane to fall iust vpon the ninetieth degree of the yard, that done, looke vpon what degree of the yarde the notch of the double socket cutteth, and that is the true altitude of the Sunne at that instant.

How

How to take the altitude of any ſtarre with Maiſter *Hoodes* ſtaffe.

Chapter. 17.

THere is no difference betwixt the order of the taking the altitude of the Sunne and of any ſtarre, but onely that in taking the altitude of any ſtarre, you muſt ſet the ende of the yarde marked with the 90. degrée to your eye, ſtaying the ſame vpon the vpper bone of your cheéke, and that in ſuch ſort as you may ſée the ſtarre by a right line paſſing from the ende of the yarde, lying at your eye to the vpper edge of the Vane at one inſtant, being alwaies ſure that the yarde lie leuell, making a iuſt Parallel to the Horizon, which Horizon is more eaſie to bee ſéene vpon the ſea, then vpon the land, for on the ſea there be neither hils nor trées to hinder the ſight thereof.

How to take the diſtance betwixt two ſtars with Maiſter *Hoods* ſtaffe.

Chapter. 18.

THe inſtrument beeing ſet in ſuch order as was firſt taught: Set the ende of the yarde marked with 90. at your eye: and let the other ende of the yarde directly point to one of thoſe Starres whoſe diſtaunce you ſéeke, and turne the edge of the vane to the other ſtar bee it on the right hande or on the left, according as you thinke good your ſelfe: Then you muſt conſider whether the diſtaunce of the two ſtarres be iuſt 45. degrées or more or elſe leſſe, for if it bee iuſt 45. degrées, then the outward edge of the Vane, and the ende of the yarde marked with 90. will bee anſwerable in your ſight to that diſtance without any more adoo. But if the diſtance bee leſſe then 45. degrées, which you ſhall eaſily perceiue by your eye (for then the Starre that is on your right or left hande, will appeare within the vane and fall ſhort thereof) then you muſt thruſt down the Tranſame in his ſocket vntill you may ſée the two ſtarres by a right line paſſing from the ende of the yarde marked with 90.

and

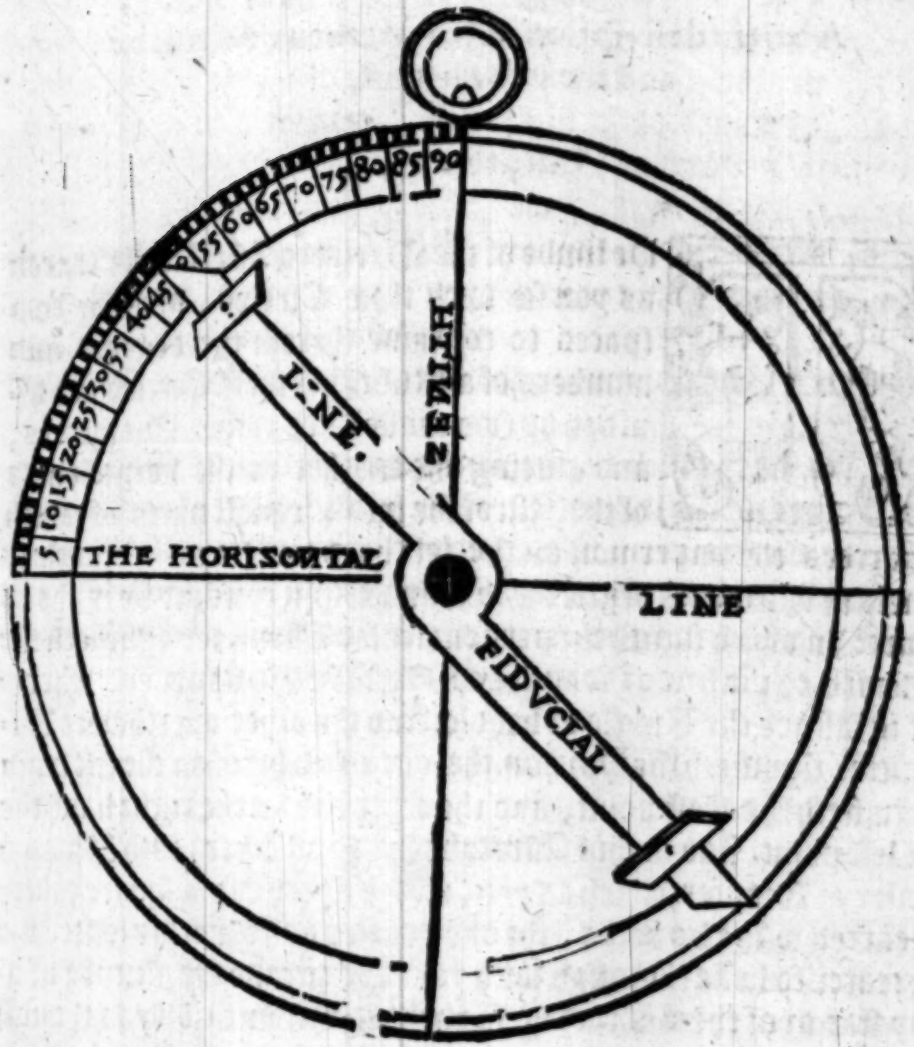
and lying at your eye, right forth to the outwarde edge of the vane, that done, looke in what degrée the double socket cutteth the Transame, and that shall be the true distance of the two starres. But if the distance of the two starres bee more then 45. degrées, which you may knowe also by your eye, because the starre which is on your left or right hande, will appeare cleane without the Uane: then drawe the double socket together with the Transame towardes your eye, vntill you may sée the two Starres by a right line as before, and the degrées which the notch of the double socket cutteth on the yarde, shall bee the true distance of the two Starres.

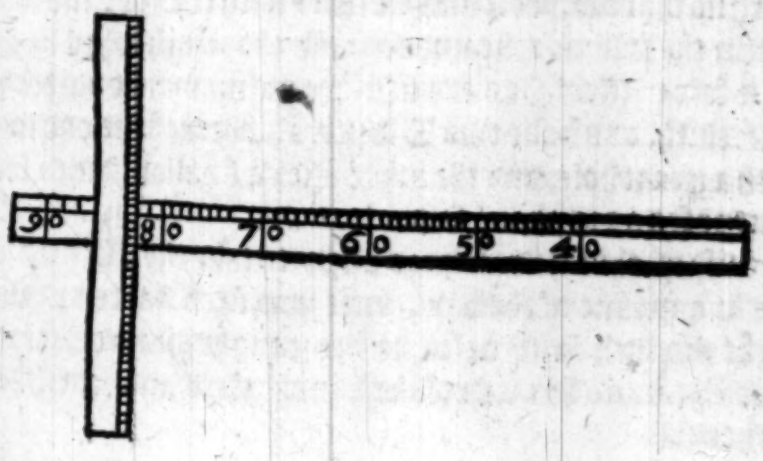
Thus much touching the Astronomicall vses of M. Hoodes staffe méete for the Mariner. Now as for setting of the said staffe to serue Geometricall vses, and to find out the manifold conclusions to be done therby, I wholly referre you to M. Hoodes owne booke, thinking it good now to speake somewhat of the Mariners Astrolabe or Ringe, and of his vsuall Crosse-staffe.

Of the Mariners Astrolabe.

Chapter. 19.

MIchaell Cogniet setteth downe the making of a new kind of Astrolabe, which he calleth an vniuersall Astrolabe, onely because the declination of the sunne euery day is added in manner of a Table to the one ende of the Diopter of the saide Astrolabe, which is of no great importance sith the sunnes declination doth alter in the space of 30. yeares and lesse, which being expired, the declination is to be new calculated: In the meane time that Table which Norman hath set downe in his Attractiue, and also that which is more lately calculated set downe by my selfe in the first part of my Spheare, and likewise in this Treatise whereas I treate of the motion of the sunne and of his declination, may serue these 20. yeares and more without any great error: Wherefore leauing to speak any further of Cogniet his vniuersal Astrolabe, I will describe here the common Astrolabe and Crosse staffe vsed by most mariners, the shape or figure of both which here followeth.


5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90
LINE.
AZIMVTH
THE HORISONTAL
LINE
FIDVCIAL


90 80 70 60 50 40

A briefe description of the Mariners Astrolabe and the vses thereof.

Chapter. 20.

THe limbe of the Mariners Astrolabe is traced as you see with three Circles, making two spaces to containe therein the degrees and numbers of altitude: and these Circles are diuided by two crosse lines called Diameters, and cutting one another in the very Centre of the Astrolabe into 4. equall parts of which quarters the vppermost on the left hand towards the Ringle is onely marked with degrees and numbers, as you may see in the figure: In which figure the perpendicular Diameter signifieth the Zenith, or the line of South and North, at the vpper end whereof is fastned the Ringle or handle. And the other ouerthwart Diameter signifieth the Horizon, the one end whereof on the left hand signifieth the East point, and the other end on the right hand the West point. And to this Astrolabe (as to all other) doth belong a ruler or Diopter, which as you see hath at ech end a square tablet pearced with two holes, the one greater and the other lesser, the greater to looke thorough with your eye, to take the altitude of any starr or of the Sun being so darkned by some cloud as though it casteth no shadow, yet it may be seene with the eye: And the lesser hole is for the Sunnes beame to passe thorough when he shineth cleare, & some Astrolabes are deuided in like maner on both sides of the Zenith, and haue two Diopters, whereof the one is pearced with a great hole, and the other with a smaller hole to serue to such purposes as is aboue said.

The vse of this Astrolabe is onely to take the altitude of the Sunne at any time of the day, or of any fixed starre or Planet in the night, in such sorte as is before taught in my description of Maister Blagraue his Astrolabe, in the third and fourth Proposition thereof.

A briefe

B
D
1000
900
800
700
600
500
400
300
200
100
C
210°
240°
270°
300°
330°

A briefe description of the Mariners Crosse staffe.

Chapter. 21.

THis staffe consisteth of two foure square rulers of woode, whereof the one is called the yarde, and the other the Transame or Crosse: And the yard containing in length most commonly thrée quarters of a yarde is the longer péce, and is deuided into 90. vnequall degrées: for from 10. to 90. the degrées doe grow lesser and lesser, and the Transame containing for the most part but one third part of the yard, is cut with a square hole in the middest, so as it may runne vp and downe vpon the yard, & some Transames haue two running vanes to be set at what widenes you list, to take thereby the distance of any two starres.

The vses of the Mariners crosse staffe.

Chapter. 22.

THe vse of the Mariners staffe chiefly consisteth in two points, that is, to knowe thereby the altitude of the Sun in the day time, or of any starre in the night season, and the other is to know thereby the distance betwixt any two starres.

The first is thus done, hauing put the staffe or yarde through the square hole of the Transame, set the end of the yard which is marked with 90. to your eye, laying that end vpon the vpper point of your chéeke bone kéeping your legs close together, and hauing directed the other end of the yard towards the sunne or star whose altitude you séeke, moue the Transame to and fro or vp & down, vntil you may sée with the one eye (winking with ỹ other) the one end of the transame to méete iust with the centre or middest of the Sun or star, & the other end to touch ỹ Horizon both at one instant, and that degrée of the yard which the square edge of the Transame cutteth, wil shew how high the Sun or star is at that présent: And in taking the altitude of the sun or of any star, remember alwaies to hold the yard so leuel as it may be a iust Parallel to ỹ Horizon, for so shal you take the altitude ỹ more truly. Now as touching the second point, which is to knowe the true distance betwixt any two stars you must do thus.

Set the end of the yarde marked with ninetie to your eye as before, and moue the Transame to and fro vntill you may see the one end of the Transame to answere the one starre, and the other end thereof to answere the other starre, for that degree of the yard which the transame cutteth, wil shew the distance betwixt the two starres: And if the two starres bee so nigh together, as they will not conueniently answere the two ends of the Transame then you may vse the two moueable vanes, which (as I saide before) you may set at what widenes you list, but yet so as they may both stand equally distant from the Centre of the Transame or from both ends thereof.

Thus hauing shewed the vse of the Mariners Ring and crosse staffe, I will now proceede to the other instruments, whereof the two Globes are part, which Globes I haue already described and shewed the chiefe vses thereof in a Treatise by it selfe, and as for the vniuersall Horologe to know thereby the equall houre of the day in euery Latitude, & also the Nocturnlabe to know the houre of the night, I shall speake of the one when I come to speak of the Sunne, and of the other whereas I treate of the North starre and of his guards, for ther I wil set downe the figure and shape of ech instrument, and shew how to vse the same: But the two chiefest instruments belonging to a Mariner, are his Compasse and his Carde, whereof I come now to speake.

But sith the Fly of the Compasse representeth the 32. winds, I thinke good first briefely to define what the wind is, and to shew how many winds the ancient Mariners did vse, I say here briefly because I haue already spoken sufficiently therof in the latter end of my Spheare.

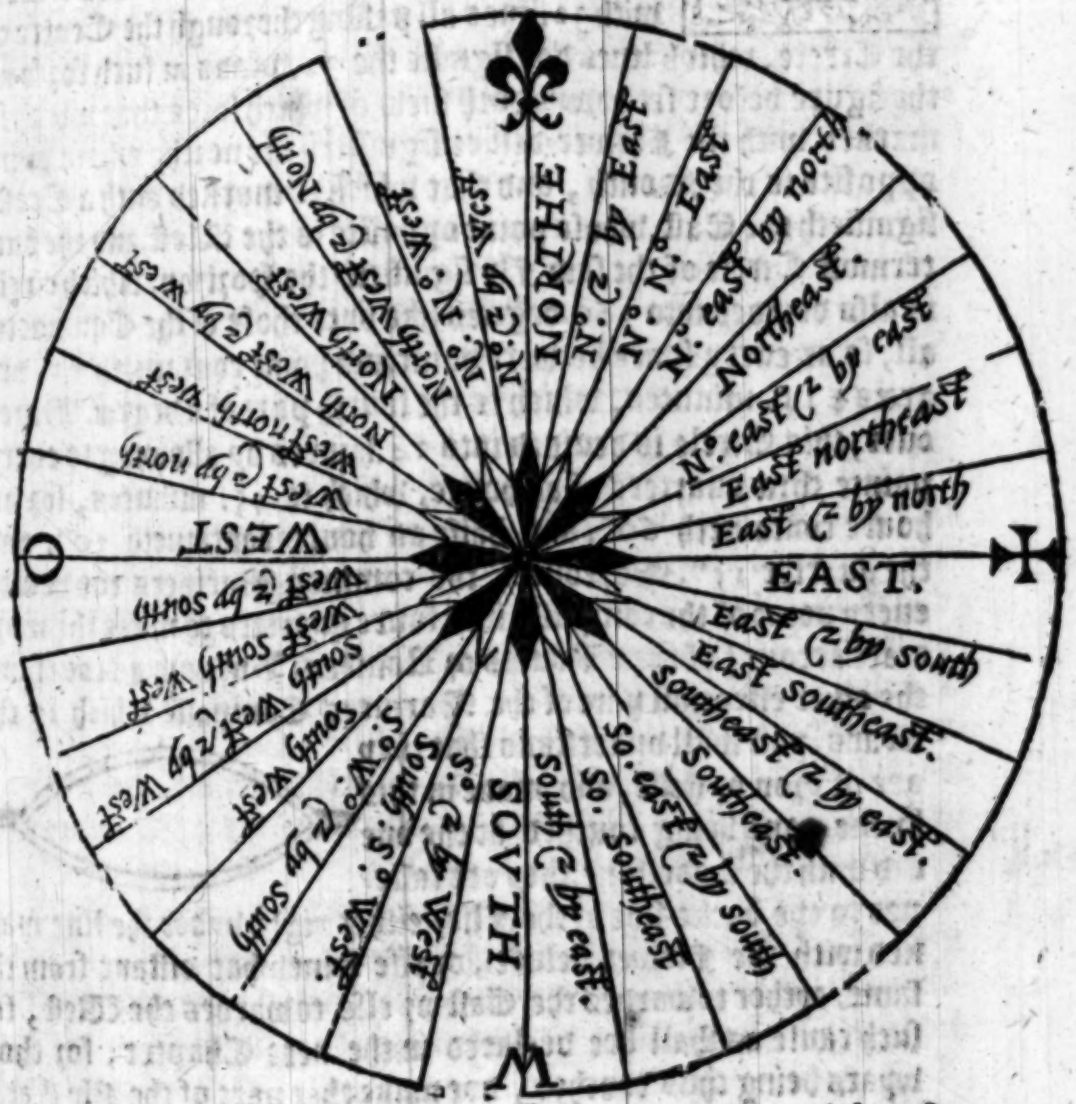
Of the winde, what it is, and of the diuers kindes and names thereof.

Chapter 23.

The winde according to Aristotle, is an exhalation hotte and dry, engendred in the bowels of the earth and being gotten out is carried sidelong vppon the face of the earth. And of windes there be foure prin-

cip all

cipall which doe take their names from the foure quarters of the earth from whence they blowe, that is North, South, East and West: and though the Grækes and Latines deuide euery quarter into thræ partes, and thereby make in all but twelue windes, whose names both Græke and Latine are set downe in the latter end of my Spheare, yet our latter Sea men to be the more assured of their Rowtes and Courses, do deuide euery quarter of the Horizon into eight windes, so as in all they make 32. winds, giuing them such names as are set downe in this figure here following, representing the Flye of the Mariners Compasse.



A briefe description of the Mariners compasse, and the vse thereof.

Chapter 24.

THe Mariners Compasse may be very well deuided into two essential parts, that is the Fly, and the wyars touched with the Lodestone called in Latine Magnes. And first you haue to vnderstand, that the fly is a round white Carde traced with 32. lines all passing thorough the Centre of the Circle, which lines doe signifie the 32. winds in such sorte as the figure before set downe doth shew, of which lines that which is marked with the Flower-deluce signifieth the north, whose point opposite is the South, and that which is marked with a Crosse signifieth the East, whose point opposite is the West, and the outtermost Circle of the said Fly signifieth the Horizon, which circle is also deuided into 360. degrees like vnto those of the Equinoctiall, so as euery space betwixt point and point containeth 11. degrees ♃ 15. minutes, which is the fourth part of a degree. Moreouer, this Circle is deuided into 24. houres by allowing to euery pointe three quarters of an houre, which is 45. minutes, for an houre containeth 60^{m}. and halfe an houre containeth 30^{m}. and the quarter 15^{m}. Moreouer, the common Mariners doe deuide euery point of the compasse into foure quarters to make the more exact account of their Routes or Rombes. But now as touching the other essentiall part of the Mariners Compasse which is the wyars, you shall vnderstand that they are of yron or steele, and made in this forme  and being touched at the one end with the Lodestone, they are fastened to the backe-side of the Flie, either right vnder the line marked with the Flower-deluce, or else somewhat distant from the same, eyther towardes the East or else towardes the West, for such cause as shall bee declared in the next Chapter, for those wyars being thus touched, doe make that part of the Fly that is

marked

marked with the Flowre-deluce, to stand alwayes towardes the Northe, and to that end the Fly hauing in the Centre a latten socket is put into a turned bore, in the middest whereof is a sharpe pointed Latten pinne, vpon which the Flie turneth about, & that turned bore is couered with glasse, partly to kéep the Flie cleane, but chiefly that the winde should not moue it to and fro. And this turned bore is hanged by two rounde narrowe plates of Latten in another square bore of thinne wainscot bowde, so as it may alwayes hang leuell, howsoeuer the shippe swayeth or inclineth on either side, and though of the Mariners Compasse there be diuers vses, as you shall perceiue hereafter, yet the chiefest end and vse thereof is to shew the Northe part of the world, whereby the Shipmaister knowing what course he hath to hold and how the port or place to which he goeth, beareth from the place from which he departeth, may by lokmg alwaies to his Compasse, know how to direct his ship accordingly.

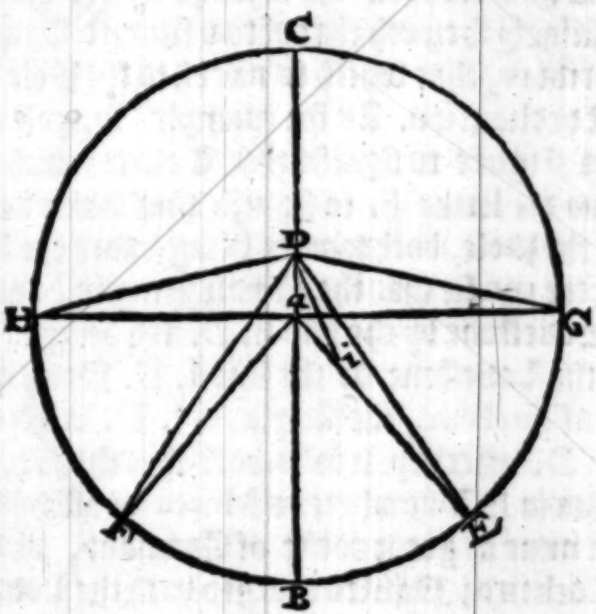
Of the Lodestone, and of the variation of the Compasse in Northeasting and Northwesting.

Chapter. 25.

THe Lodestone or Adamant, called in Latine Magnes, & in Italian Calamita, hath two marueilous great and secret properteies or vertues, the one to drawe steele or Iron vnto it, and the other to shewe the Northe and South parte of the worlde, of which stones some be of more force than others according to the place from whence they come. For those are counted best which are found in the East Indies vppon the coast of China and Bengala, which is no shell but a whole stone of sanguine collour like to Iron, and is firme, massie, and heauie, and will drawe or lift vppe the iust waight of it selfe in Iron or steele. And as Norman sayth in his newe Attractiue, such Stones are commonly solde for their waight in Siluer.

Next to this, Norman commendeth the redde stone of Arabia, hee commendeth also the stone of Almayne, which is in collour like to Iron, but spongeous, and thereby lighter than the other. And as for the blacke and white stone of Elba, which is an Ilande, not farre from Piombino, he saith that the vertue thereof is but of small force, and of no long continuaunce. But the worste are those that come from Norway, whose collour is mixte with graye, I haue hearde that there bee of them here in Englande, but howe good I knowe not, it is maruell that Norman maketh no mention thereof, whose Treatise called the newe Attractiue, together with Maister Borough his addition I woulde wish all that be studious in this Arte to read most diligently, for truely in mine opinion the secretes of this Stone and variation of the Compasse, was neuer better discyphered, nor by more experiences tried than it hath bene by these two men last named. The booke is most necessarie for nauigation and of an easie pryce, mete for euery poore mans purse, though perhaps in some poyntes not mete for euery mans vnderstanding. Now whensoeuer the wyars are to be touched with this stone, they must be made very clean and void of all ruste to the intent that the Iron may the more firmely receyue the vertue of the stone. And it is well knowne by good experience, that by vertue of the Lodestone the North point of the Compasse declineth alwayes from the true North, either to the East, or West more or lesse according to the latitude of the place wherin you are vnlesse you be right vnder the Meridian of the Azores. And therefore most men in these partes of the worlde doe vse to set the North point of the wiers not right vnder the Floure de Luce signifying the North part of the world, but rather somewhat inclyning towarde the East halfe a point or there about to auoide the Northeasting and Northwesting of the Compasse, the cause of which declination by diuers learned men hath beene diuersly taught, but not rightly as Michaell Cogniet saith, vntill Mercator found out the true cause, who first learned by the experience of one Francis of Deepe, an excellent Pilot, that in sayling vnder the Meridian which passeth through the Iles called the Azores the nedle doth decline neither East nor West, whereupon Mercator

cator by calculating the variation of the Compasse at Ratisbone, found that the Pole of the Lodestone ought to be put in that Meridian which passeth through the foresaid Iles, so as it may be distant from the Pole of the world sixteene degrées and ½. or rather as Maister Borough saith, sixteene degrées and twentie two minutes, and by that calculation Cogniet hath found the variation of the Compasse at the towne of Antwerp to be 9. degrées. And Maister Borough by the helpe of the new instrument of variation first made by Robert Norman, and afterward perfected by himselfe, haue found the variation for London to be 11. degrées and fifténe minutes, which is a whole pointe from North to East. But whensoeuer you depart from the foresaide Meridian of the Azores, be it neuer so little, either towardes the East or West, the nédle will varie and decline accordingly. And his greatest declination is when you come to a full quarter of that Parallell wherein you sayle, for from thence it declineth lesse and lesse vntill you come againe vnder the foresaide Meridian, which thing Cogniet doth plainely Demonstrate by this Figure here made of purpose.



In which figure the letter A. which is in the very center of the Circle representeth the North Pole, and the right line

ked with the letters C. B. signifieth the Meridian which passeth through the Iles Azores, in which line is a point or pricke marked with the letter D. signifying the Pole of the Lodestone, distant from the North Pole sixtéene degrées and a halfe. Nowe, if your ship be in the point B. then your nédle declineth on neither side, but pointeth right to the North Pole, and also to the Pole of the Lodestone. But if you sayle Eastward and arriue to the point E. then the right line of the north is E. A. but your nédle declineth on the right hand towardes his owne Pole D. which is to the East, so much as the Angle A. E. D. doth shewe. Likewise if you sayle from B. Westward to the point F. the right line of the North shall be F. A. but your nédle will decline to his owne Pole D. towardes the West, so much as the Angle A. F. D. doth shew. And to be short, the nédle doth neuer shew the right North, but onely in C. or B. to either of which points the nigher that you approch the lesse your nédle declineth, & the more that you go from anyof these two pointes the more your nédle declineth either East or West, but the greatest declination thereof is in H. or G. for then you are a iust quarter from the foresaid Meridian. Also by this Figure he plainely sheweth that of two sundrie Townes hauing one selfe Meridian, that which is néerest to the Pole of the world hath greatest declination. As for example, suppose the letter I. in the foresaid Figure to signifie that Towne which is nigher to the Pole, and the letter E. to signifie that towne which is more distant from the Pole, both townes being vnder one selfe Meridian E. A. Heere you sée that the Nédle being in E. doth shewe the Pole of the Lodestone by the line E. D. and being in I. it sheweth the Pole of the Lodestone by the line I. D. Nowe according to the doctrine of Euclyde, the Angle A. I. D. is greater than the Angle A. E. D. whereby it followeth that the Needle declineth more in I. than in E. But whereas Mercator affirmeth that there shoulde bée a mine or great rocke of Adamant, whereunto all other lesser Rockes or Nédles touched with the Lodestone doe incline as to their chiefe fountaine, that opinion sémeth to mée verie straunge, for truely I rather beléeue with Robert Norman, that the properties of the Stone, as well in drawing stéele, as in shewing the North Pole, are secrete vertues giuen of G O D

to

to that stone for mans necessarie vse and behoofe, of which secrete vertues no man is able to shew the true cause.

How to finde out the variation of the Compasse in euerie Latitude.

Chapter. 26.

WIlliam Boorne in his Regiment of the sea teacheth diuers waies how to find out the variation of the Compasse, as well by the Sunne in the day time, as by the Nexth starre in the night season. First, thus mark at what point of the Compasse the Sunne riseth & setteth, for if he riseth at the East point of the Compasse, and goeth downe at the West Northwest pointe, then the Compasse is varied one whole point, that is to say, the Nexth point of the Compasse standeth North and by East. But because the aire is seldome cleare at the rysing and setting of the Sunne, you may doe thus, take with your Astrolabe or crosse staffe the altitude of the Sun in the forenoone, the sooner the better, at some iust point of the compasse, and take againe his altitude in the afternoone, when hee is in like degrée of altitude, and marke therwith at what point of the Compasse the Sunne hath such altitude, and by the difference thereof you shall know the variation of the Compasse. As for example, you finde by your Astrolabe or crosse staffe, that the Sunne is 20. degrées high at the Southeast point of the Compasse, and obseruing the same againe in the afternoone you finde his height to bee 20. degrées at the West Southwest point of the Compasse, whereby you sée that the Compasse is varied one whole point, that is to say, that the North point standeth North and by East, and the South point is South & by West. He teacheth it also another way, which is thus.

Take with your crosse staffe or Astrolabe the height of the Sun at noonetide, which is called the Meridian altitude of the Sunne, and thereby you shall haue the true Meridian of the place where you

you are, with which Meridian if the South point of your Compasse doth agree, then your Compasse hath no variation at all, but if the South point therof do swarue or incline on either side from the said Meridian, marke how much it differeth, & that difference will shewe you the variation. Nowe to know the variation of the Compasse by the North starre, doe thus, set your Compasse with the North starre, and if you finde them to agree, then there is no variation, but note that this is to bee done when the two guardes or pointers of Charles waine are right ouer or right vnder the North starre, for if these two starres bee West from the North star, then the North star is a third part of a point vnto the Eastward of the North Pole, and if the said two starres be right East from the North starre, then the North starre is a third part of a point vnto the Westward of the North Pole.

The Compasse (as Bourne saith) doth varie most in sayling long voyages East and West, and though it varieth two or three points, yet you may know what course to holde without alteration of the Wyers any maner of way. As for example, suppose the Northeast point to stand right North, and your course is to goe right West, here in this case you may vse the Southwest point in steade of the West point, whereby you may perceiue, that it maketh no great matter, which point standeth due North, so as you take that pointe of the Compasse for the North, which directly pointeth to the North. But Robert Norman and Maister Borough by the help of their new inuented Instrument of variation, doe shewe howe to finde out the variation of the Compasse much more exactly than euer it hath bene heeretofore taught, which instrument together with the booke, I would wish all Sea men to haue, and therby to learne the perfect vse of the instrument, which vse that booke teacheth both plainly and learnedly, in which booke is also proued by diuers demonstrations that there is no such attractiue point as some haue dreamed, but rather a respectiue point whereunto the needle of your Compasse will alwaies turne in what part of the world soeuer you saile. But of the place where that respectiue point shoulde bee, diuers learned Pilottes haue had diuers opinions, for some haue imagined it to bee in the heauens, and some aboue the heauens, if it were in the heauens, then

the

the nædle woulde dayly turne about, and alter accoꝛding to the motion of that heauen, wherein the ſaid point is, which is nothing ſo. And to bee aboue the heauens, it is contrarie to the olde rule of Philoſophie, which ſayth that Extra Cœlum non eſt locus, and therefoꝛe Norman and Maiſter Borough haue great reaſon to ſaye that it is in the bòdy of the earth beneath the Hoꝛizon, foꝛ they haue tryed by diuers liuely experiments that the Noꝛth parte of the nædle of his owne accoꝛd and nature would alwayes decline downwarde if it be not otherwiſe counterpoiſed oꝛ letted, & by their demonſtrations ſuppoſing the Meridian of the Azores to be the firſt oꝛ common Meridian, and alſo knowing the altitude of the Pole at London to be 51. degrées, 32. minutes, they finde that accoꝛding to that Latitude the Pole of the Lodeſtone, being in the vpper face of the earth, and right vnder the foꝛeſaide common Meridian is 25. degrées 44. minutes diſtant from the Pole of the woꝛlde. And the point reſpectiue to bee diſtant in a right line from vnder the Hoꝛizon of London 71. degrées, 50. minutes and the variation of the Compaſſe to be as hath bène ſaid befoꝛe, 11. degrées and 15. minutes, but to find out the true place of the reſpectiue point in euery latitude, they ſay, that no certaine rules can as yet be ſet downe, by reaſon that the Compaſſe doeth varie moꝛe ſodenly in one place than in another, foꝛ in ſome place it wil vary moꝛe in ſayling 200. leagues than in another place in ſayling 400. leagues. Againe, it will ſometimes be retrograde, foꝛ M. Borough in ſayling betwirt the Noꝛth Cape and Vaigates, towards the Noꝛtheaſt, and looking by his computation that the nædle ſhould haue increaſed his variation towardes the Eaſt, hée found that it was ſodenly turned backeward towarde the Weſt, notwithſtanding both Norman and M. Borough do affirme that though the Compaſſe hath in ſeuerall Hoꝛizons ſeuerall variations, yet in any one Hoꝛizon the nædle alwaies reſpecteth one onely pointe without alteration, and that in his declyning it kæpeth the like oꝛder and that certainly in euery place. And although the nædle of the Compaſſe by reaſon of the waightineſſe of the Flie cannot decline downward accoꝛding to his own pꝛoperty, but onlie ſheweth the point reſpectiue alwayes vpon the Hoꝛizon, which indéd, as they ſay, is moſt neceſſary foꝛ nauigation, yet by ſuch

meanes

meanes and conclusions as are set downe in the foresaid booke, a diligent Pilot hauing with him a perfect stone may by exact obseruations find out the increasing or decreasing of the declination of the nædle, which declination you shall find, as they thinke to be more or lesse according as the point respectiue is more or lesse distant from the place whereas the tryall is made, which being diligently obserued in sundrie places, with the certaine variation of the nædle from the Meridian, the true place of the point respectiue may be found out as they thinke.

But there be three causes which moue me to thinke that the respectiue point wil neuer be truely found out, first for that the Meridian which in these dayes is supposed to bee the first Meridian passing through the Azores, and spetially through the Iles S. Marie and Saint Michael. Is not that Meridian vnder which the Mariners compasse doth rightly point, as well vnto the Pole of the Lodestone as also to the North pole of the world, for though Fraunces of Dæpe found it so by his Compasse, yet diuers learned Pilots since his time hauing sayled vnder that Meridian, haue found the variation of their Compasse to bee as much there as else where, and not rightly to point to the respectiue point, which is supposed to bee vpon the earth, and without such a certaine Meridian no true account from any Latitude can be made. The secoude cause which moueth me to thinke as before, is for that the Compasse in some place of the Sea will bee suddenly retrograde, which thing M. Bourough by his owne experience affirmeth to be true, as is before set downe. The third cause is, for that I doe verily beléeue the finding out of the true place of the respectiue point to be as great a secret in nature, as it is to know the cause why the Lodestone shoulde haue such vertue to drawe stéle vnto it, and to shew the North Pole of the world which are two secret gifts giuen to the stone of God for mans behoofe, & yet the cause thereof not to bee found out by man, though most carefully sought by the greatest Phylosophers that euer were.

Of

Of the Mariners Carde, and of the making thereof.

Chap. 27.

The Mariners Carde, which some call a nauticall Planisphеare, is none other thing, but a description made in Plano vpon paper or parchment of the places that be in the sea or on the land next adioyning to the sea, as points, capes, Bayes, ports, Flods, Ilandes, Rockes, Sandes, and such like, And such Cardes are either vniuersall or particular, the vniuersall Cards are those wherein are described the most partes of the world, such as is the vniuersall Carde or Map of Mercator, or of Plancius. The particular are those wherein some speciall partes of the sea and land are described. And both these kinds of Cardes are traced with certaine lines, wherof some are called Meridians, some Parallels, and some the Lines of the Mariners Compasse, shewing the 32. winds before described in the beginning of this Treatise. The order of making which Cards in times past was wont to be thus.

First drawe with a paire of compasses a secret circle that may be put out, so great as you shall thinke meet for your carde which circle shall signifie the Horizon, then diuide that circle into foure equall quarters, by drawing two Diameters crossing one another, in the Center of the foresaide Circle with right Angles, whereof the perpendicular line is the line of North and South, and the other crossing the same is the line of East and West, at the foure ends of which crosse Diameters you must set downe the foure principall windes, that is, East, West, North and South, marking the North part with a Flower-delice in the toppe, and the East parte with a crosse, as you may see in the figure following. Then deuide euerie quarter of the saide Circle with your Compasses into two equall partes, setting downe prickes, in the middest of euerie quarter, through which Prickes, and also through the center of the circle, draw two other crosse lines, which must extende somewhat beyonde the circumference of the Horizon, which two crosse lines together with the first two crosse lines shall diuide the Circle into 8. partes, and thereby you shall haue

the

the eight principall Windes. That done, diuide euery eight part of the saide Horizon into two equall parts by drawing other two crosse lines through the Center, and extending somewhat beyond the circumference of the Horizon as before, whereby the whole circle shall be diuided into 16. partes, which shall suffice without making any more diuisions, which would cause a confusion of lines, and at the end of euery one of these 16. lines you must drawe a little Circle, whose Center must stand vppon the circumference of the Horizon, euery one wherof must be also diuided into 16. parts by helpe of the 16. lines, diuersly drawne from the Center of one little circle to another, in such order as the figure here placed more plainly sheweth to the eye, than I can expresse the same by mouth. And these little circles doe signifie 16. litle Mariners compasses, the lines whereof signifying the windes, doe shew how one place beareth from another, and by what wind the shippe hath to saile. But besides those litle circles there is wont to be drawne also another circle somewhat greater than the rest vpon the very Center of the Horizon, which Circle by reason of the 16. lines that were first drawne passing through the same, is diuided into 16. partes, and the Mariners doe call this Circle the mother compas.

Here place the Mariners Carde.

The shape & figure of the first liniaments of the Mariners Carde drawne after the old maner, and how to set downe the places of the land or sea therein.

Chapter. 28.

NOw the true setting downe of the places in the Mariners carde, as Points, Capes, Bayes, Flouds, Ilands, and such like is to bee done by knowing what Latitude and Longitude euerye place hath, which is to bee learned either by moderne Tables made of purpose: for the auncient Tables make no mention of any longitudes or latitudes

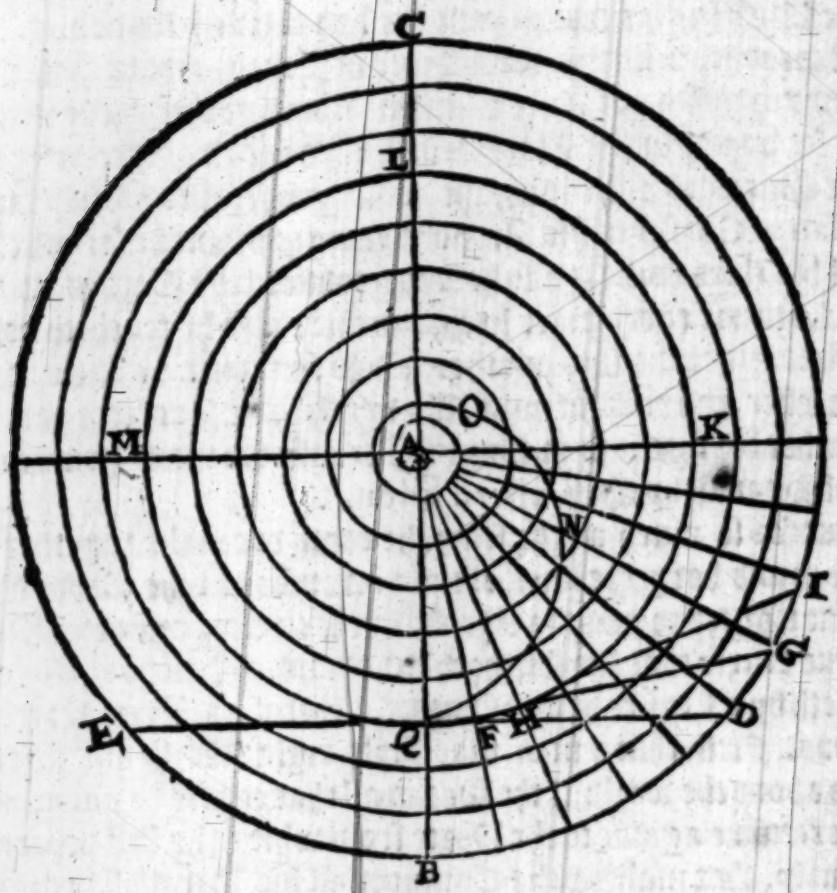
tudes of such places as are in the newe found land, which land to them was neuer knowne, or else by such Mariners cardes already made as doe shewe the true Longitudes and Latitudes of those places which you would describe in your Carde, of which Longitudes and Latitudes, and especially the Longitudes of the places in the West Indies, few or none are as yet truely set downe.

Moreouer, to knowe the distance of places, that is, how many leagues or miles one place is distant from another, there is woont to be set downe in the Mariners Carde a scale, otherwise called by the Mariners a Tronke, the making wherof is plainly taught by Martin Cortes in his Arte of Nauigation, in the second chapter of his third booke, & also how to graduate the Cardes, to shew what Latitude euery place hath, and there also he teacheth how to translate one carde into another, & how to reduce a greater carde into a lesser, and contrariwise. To which booke I referre you, and the rather for that it is in English, translated many yeares since out of Spanish by M. Richard Eden.

But for so much as the sea & the earth doe make together one whole round body, the lines of the 32. rombes in the Carde being drawne right, and made to signifie great circles, can neuer shewe the true course that the ship hath to hold, which Michael Cogniet prooueth by a Figure demonstratiue, & therof gathereth three conclusions. First, that a man may sayle right North and South round about the world, if the Sea in all that course be nauigable, and so returne againe to the Porte from whence he first departed. Secondly, that making the Equinoctiall his Parallell hee maye sayle East and West round about the world, and so returne to the porte from whence he departed. Also if he sayle East and West in any other Parallel that is distant from the Equinoctiall, hee may returne by the same Parallel to the port from whence he first departed, & yet not about the whole world, for that cannot be done, but onely when the Equinoctiall is his Parallel. Thirdly, that whosoeuer sayleth by any other rombe than by one of the foure principall, he by often changing his Meridian and Horizon must néeds sayle by a line Spirall, which is neither perfectly right, nor perfectly round, and thereby he may well approch the Pole, and also goe round about it, but yet with vnequall distance, so as hee

shall

shall be nigher beyond it than on this side, by meanes whereof he cannot returne to the place from whence hee came, as you may plainly perceiue by this Figure demonstratiue here placed.



In which Figure the letter A. doth signifie the North Pole, and the letters B. C. the Meridian passing through the Pole A. then suppose your ship to bee in Q. whereas the Pole is eleuated 30. degrées and Q. to bee your Zenith, and the right line G. Q. D. to bee your right line of East and West cutting the foresaide Meridian with right Angles, and let D. be the East point, and E. the West point.

Nowe you may sayle from Q. towardes the North with a South winde, and from A. you may sayle againe Southward with

with a North winde vntill you come to the South Pole, and from thence you may sayle againe Northwarde with a South wind vntill you come againe to Q. from whence you first departed, and so you shall haue gone rounde about the worlde vnder one selfe Meridian B. A. C. But in sayling East or West, you shall continually change your Meridian, and thereby change your East point, for in sayling from Q. towardes D. you come immediately to the Meridian *A.* F. whose right East point is G. and in sayling further Eastwarde, you come to the Meridian A H. whose right East poynt is I. and so forth from one Meridian to another, notwithstanding in kéeping still in one selfe parallel marked with K. I. M. you may sayle rounde about the Pole A. which is the center, and so come againe to the Port Q. from whence you first departed, but not about the whole worlde: for that you cannot doe vnlesse the Equinoctiall were your Parallell as hath béene saide before, but if you sayle by any other rombe than by one of the foure principall, that is, East, West, North, or South, your course shall neyther be by right line, nor yet by true circle, but by a spirall line, which is partly right, and partly rounde, so as you cannot with like course returne to the place from whence you departed, by reason that you change so often both Meridian and Horizon, as by the Spirall line Q. N. O. drawne in this figure you may easily perceyue, which approcheth nigher to the Pole beyonde it then on this side. Moreouer the sea men by making the Meridians and parallels in their cardes all of equall distance, they make some countries far greater then they shoulde be by the one halfe. Also by that meanes hee that sayleth East and West rounde about the Pole in the Parallel whose latitude is 60. degrées, shoulde make as long a voyage as he that sayleth East and West alongst the Equinoctiall, the voyage whereof is twise as long as the other, for the redresse and remedie of which faultes, Cogniet hopeth to find out some more perfect rule of making Cardes when opportunitie of time shall serue: in the meane time to reforme the saide faults, Mercator hath in his vniuersall Carde or Map made the spaces of the Parallels of latitude to bee wider euery one then other from the Equinoctiall towardes eyther of the Poles, by what rule I knowe not, vnlesse it bee by such a Table, as my friende M. VVright of

Caius colledge in Cambridge at my request sent me (I thanke him) not long since for that purpose, which Table with his consent, I haue here plainely set downe together with the vse thereof as followeth.

Here must you place the Draught of the Meridians and Paralels of the Mariners Carde.

A Table

A Table to drawe thereby the Paralels in the Mariners Carde together with the vse thereof in trewer sort than they haue beene drawne heretofore, and the vse thereof.

Chap. 29.

Degrees of the Meridian beginning from Equinoctiall Circle.	Equall partes of the Meridian in the Mariners carde of which parts euery degree of the Equinoctiall containeth 60. miles.	Degrees of the Meridian beginning at the Equinoctiall circle.	Equal parts of the Meridian in the Mariners carde, of which parts euery degree of the Equinoctiall containeth 60. miles.
1	60	27	1684
2	120	28	1752
3	180	29	1820
4	240	30	1889
5	300	31	1959
6	361	32	2029
7	421	33	2100
8	482	34	2173
9	542	35	2245
10	603	36	2319
11	664	37	2394
12	725	38	2470
13	787	39	3546
14	849	40	2624
15	911	41	2703
16	973	42	2783
17	1035	43	2865
18	1098	44	2948
19	1162	45	3032
20	1225	46	3118
21	1289	47	3205
22	1354	48	3294
23	1419	49	3385
24	1484	50	3477
25	1551	51	3572
26	1617	52	3668

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13	787	39	3546
14	849	40	2624
15	911	41	2703
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23	1419	49	3385
24	1484	50	3477
25	1551	51	3572
26	1617	52	3668

Degrees of the Meridian. &c.	Equall partes of the Meridian. &c.	Degrees of the Meridian. &c.	Equall partes of the Meridian. &c
53	3767	67	5482
54	3868	68	5639
55	3972	69	5804
56	4078	70	5976
57	4187	71	6156
58	4299	72	6346
59	4414	73	6547
60	4532	74	6759
61	4655	75	6985
62	4781	76	6226
63	4911	77	7484
64	5046	78	7764
65	5189	79	8067
66	5331	80	8399

THe vse of this Table for making the sea Carde is thus. Ouerthwart the middest of the plaine superficies wherein you would drawe the lineamentes of the Carde, describe a right line marked with the letters A. B. C. whereof B. is the very middest or center, and this line representeth the Equinoctiall, the ende whereof on the right hande, marked with the letter C. signifieth the East, and the other ende on the left hande marked with the letter A. signifieth the West, which Equinoctiall line must be deuided into 360. degrees, then crosse the same squirewise with perpendicular lines, passing through euery tenth or fift degree, as you see in the example following. Then take with your compasses the length of halfe the Equinoctiall, that is, 180. degrees, and set one foote of your Compasses in the mutuall intersection of the Equinoctiall, and of that perpendicular or Meridian, which passeth through the East ende of the Equinoctiall line, marked with the letter C. and with the other foote make a pricke in the same perpendicular or Meridian, and marke that pricke with the letter D. that done, diuide the space contayned betwixt this pricke and the E-

qui-

quinoctiall firſt into three equall parts, and euery one of thoſe into other three equall parts, ſo haue you 9. parts. And againe euery one of thoſe into three, ſo haue you twentie ſeuen parts, & diuide euery one of thoſe parts into foure parts, ſo ſhall you haue a hundred and eight parts, and if there be ſpace enough, diuide againe euery one of thoſe into ten, ſo ſhall you haue a 1080. parts & if it be poſſible, diuide againe euery one of thoſe parts into other 10 ſo ſhal you haue in al 10800. partes, but this can hardlie be done, vnleſſe the carde be verie large, wherein euery degree of the Equinoctiall is nere an inch long, which happeneth very ſeldom, and therefore 1080. parts ſhall ſuffice.

And for the eaſier numbring of theſe parts, ſet to them Arithmeticall figures with blacke leade, which may afterward bee put out when your worke is done, beginning at the Equinoctiall and ſo proceede from thence both Northward and Southward. then looke what number ſtandeth right againſt euerie degree in the former Table, which degrees doe extend from one to foureſcore degrees. and omitting alwaies the firſt figure on the right hande of that number which you finde, for ſo you muſt alwaies doe when your diuiſiõ containeth no more but 1080. parts, count that number which remaineth vpon the line of diuiſion, and there make one pricke, and make an other pricke of the ſame diſtance from the Equinoctiall vppon the outermoſt Meridian on the left hande, through which two prickes draw a right line, and that ſhall bee your firſt Paralell of latitude, and ſo proceed with all the reſt firſt Northward, and then Southward, if you minde to make an vniuerſall carde. But the example following containeth no more but the one halfe of an vniuerſall card proceeding from the Equinoctiall line Northwarde vnto the 80. degrees of Latitude: for further Northward than 80. degrees is no land as yet diſcouered or knowne, nor yet all that, ſo farre as euer I could learne.

IN this last figure or Table is first drawn (as you se) the Equinoctiall line marked with the letters A.B.C. and that line is deuided into 360. degrees, and therein also are drawne perpendicular lines, as well thorough the beginning and ending of the said Equinoctiall line, as also through euery tenth degree thereof, which be the Meridians, and are euery where equidistant each one from other, then take halfe the length of the Equinoctiall which is A. B. or B.C. with your Compasses, and setting one foote in the end of the Equinoctiall marked with C. make with the other foote a pricke at D. in the Meridian or perpendicular line marked with the letters C.D. E. then deuide the space contained betwixt C, and D. into 1080. parts in such sort as before hath bin shewed, and set the Figures vnto them as heere you se, to the intent that you may the more readily number the parts. Then looke in the first Table what number answereth to euery 10 degree of the Equinoctiall, and casting away the first Figure of that number on the right hand, finde out the parts answerable to the number remayning in the line C.D. & at those parts set pricks in both the outward Meridians, through which prickes you shall draw the Paralels. As for example in the first table you se that the number right against 10 degrees is 60. (the first figure 3. towards the right hand beeing reiected) therefore looke 60. in the line C.D. and by that part drawe the first Paralell distant 10. degrees from the Equinoctiall. And after this manner all the rest of the Paralels are to be drawne.

Many doe vse to paint the vacant places in their Cardes with ouer many flags, and the compasses thereof with diuerse and superfluous colours which V Villiam Borne misliketh, wishing that in stead thereof they would shew by letters or other Characters what Woone doth make a ful sea, in such places as are necessarie to be knowne, and also to draw the true shape and fashion of euery Cape or headland that is needfull about the coast, and at what point of the compasse the land riseth of this or that fashion, for beeing neare the land it will seeme to be of one fashion, & being farre off to bee of an other fashion, and to mistake any place on the sea is very dangerous to the Mariner. But aboue all thinges let him that sayleth by Card and Compasse be sure that the needle of his compasse haue the like declination that his needle had which made

made the Carde. For Cognet reporteth that certaine Mariners being in the West Indies, and seeing the North star to be North-east, marvailed thereat very much not knowing the cause of that errour, which indeed was for that the needle of their compasse was made to decline Northeast, whereas it should rather haue declined Northwest, for the West Indies doe stand Westernly from the Azores. It is necessarie also to set downe in the Card such places as are dangerous, as sands, flats, shoulds, rockes, and such like thinges as are not alwaies to be seene with the eye, to the intent that the Mariner being aduertised thereof may shunne the same. All which thinges before mentioned, V Vagoner hath in all places contained in his booke very well obserued. Thus hauing spoken sufficiently of making the Mariners Carde, now I thinke it good to shew the most necessarie and chiefest vses thereof.

The chiefest vses of the Mariners Carde.

Chap. 31.

THe chiefest vses of the sea Carde are these foure heere following.

The first is to know thereby how that place whereunto you would saile, beareth from the place or Port from whence you set off, or depart. And that is to bee knowne by the lines of the Mariners Compasses painted in the Card in this manner following: Take a paire of Compasses, and hauing opened them, set the one foot thereof in the very place from whence you depart, and the other foote in the next line of that Compasse which is nerest vnto your place of departing, I meane such a line as doth most rightly direct you to the place to which you would goe, and your Compasse being opened at the fit widenes to serue that line, draw them from the place of your departing vnto the place whereunto you would go, suffering the foot of the compasse which standeth vpon the line of the wind whilest you draw it forward, not to swerue one iot from that line, and that line will either rightly direct you to the place assigned or fall short thereof, or els ouerreach the same if it fall short, then take another line nearer to the place from which you departed, and if it ouerreach, take some line that is further off from the place of your depar-

ting, and hauing found a line that pointeth directly to the place, consider what winde or rombe it is, for by that winde the place assigned beareth from you, and the rombe or winde opposite to that is the winde whereby you haue to sayle.

The second vse is to knowe by the Carde how farre the place whereto you go is distant from the place of your departing, which is done by help of the scale or trunke set downe in the Card thus: Take the iust distance betwixt the two places with your compasses by setting the one foot in the one place, and the other foote in the other place, and apply that widenes of the compasses to the scale or trunke, and the trunke will shew howe many Leagues the one place is distant from the other, and if the distance betwixt the places bee longer then the trunke, then take first the length of the trunke with your Compasses, and loke how manie times that is contained in the space betwixt the two places, and if there doe remaine any odde measure, then hauing taken that odde measure with your Compasses by setting them at such widenes as is answerable to that odde measure, applie that widenes to the first part of the trunke, so shall you knowe the iust measure of the whole. And this rule serueth to take the true distance of any other two places whatsoeuer set downe in the Carde.

The third vse is to know by the Caroe what Latitude or altitude of the Pole any place set downe in the Card hath, which is done by help of the line of degrées of Latitude, otherwise called the Graduation of the Card in this manner following. Set the one foote of your compasses in the verie place whereof you would know the Latitude, and the other foote in the line of East and west, which is next vnto that place, and képing that foot still vpon that line, draw your Compasses forward vntill you come to the line of degrées, & marke what degree of the said line the foot of the compasse, which was first set in the place doth crosse or touch, for that is the degree of latitude for that place, numbring from the lowest degrée of Graduation vpward, so shall you finde the Latitude of Lisbone in Portingale by Mercator his vniuersall Carde, and by the Carde set downe in Martin Cortes booke, and also by Medina his Card drawne in his booke of Nauigation to bee 38. degrées, 30. minutes and somewhat more. But by the Tables of Ptolomie you shall finde it to be 40. degrees 24. minutes, and

by

by Appian his Tables to be 39. degrees and 38. minutes.

The fourth vse chanceth when you are driuen out of your right course by stormes or tempest which stormes how to foresee and to prognosticate, is plainely taught by Martin Cortes in the 19 chapter of his 2. Booke. Also you may bee driuen by force of contrarie windes, by surging of the sea, or by ouerthwart tides, currants, & such like impediments, so as you cannot lay your course right to the place assigned, for remedie whereof you must seeke in what place you are, & to note the same in your Carde which as the Mariners terme it, is to make a pricke in the Card, which to doe truelie in time of need many things are to be known & well obserued and kept in memorie. First to know what latitude the place from whence you first departed hath, then to keepe in mind what way your shippe did make good at euery shift of winde, that is to say, how manie leagues, and in how long time you sailed by euerie seuerall winde: and then not knowing well where you are, nor how farre you are distant from the place whereunto you would go, learne to knowe by helpe of your Astrolabe or crosse staffe, in such sorte as is before taught, the altitude of the Pole in that place where you are, which if you finde to bee all one with the Latitude of the place of your departure, then you may assure your selfe that you haue sayled by the line of East and West without altering your Latitude, but if you finde the Latitude of the place where you are, to bee more or lesse then the Latitude of the place from whence you departed, then resort to your Carde, and take two paire of Compasses opened at such wideneſſe as the one foote of the one Compasse may stand in the place from which you departed, and the other foote of the same Compasse to stand in the line of the rombe whereby you sayled: and let the one foote of the other Compasse stand in that degree of Latitude which you last found, and the other foote of the same Compasse in the next line of East & West, and holding the Compasses so ordered in each hand one paire: draw them both so as they may meete together, taking good heed in drawing them, that the foote of that compasse which was placed in the line of the winde, may at no time swarue from that line, nor the one foote of the other Compasse to swarue from the line of East and West, wherein it was first placed, and whereas the two feete of those compasses doe meete,

that

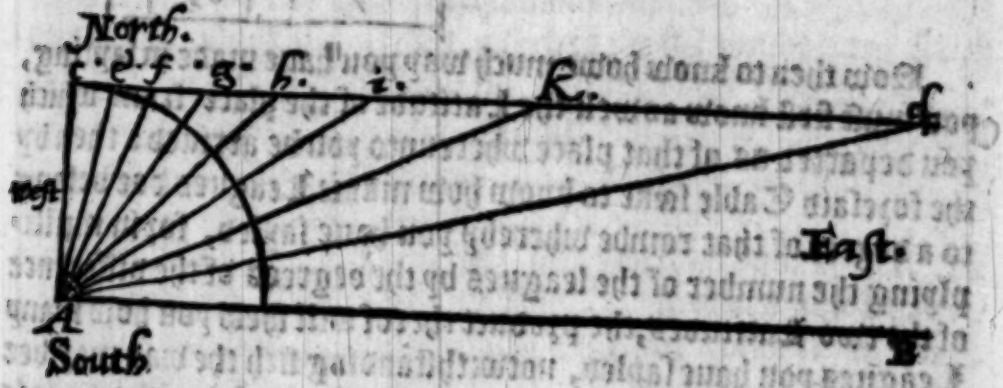
that is to say, that foot of the one Compasse which was drawne from the place of your departing doe meete with that foote of the other compasse which came from the degree of latitude last found, where these two feet (I say) doe meete, there make a pricke or marke in your Card, for that is the place where your shippe is at that instant: And from thence you must take your right course againe to the place whereunto you would goe. But because it is necessarie as well at this time as at all other times, to knowe what way your shippe hath made, and that the same is not in mine opinion, so plainely nor so commodiously taught by any one that I haue read, as by Michaell Cognet, I mind therefore in the two chapters next following to set downe his way not onley howe to finde out the way of your ship when you saile South and North vnder one selfe Meridian, or in any other place where you are to change in your gate the Latitude or altitude of the Pole, but also how to find out the way of your shippe in sayling right East and West, without changing the altitude of the Pole, which way as he saith, was neuer heretofore knowne to any Pylot but to himselfe first author and inuenter thereof.

How to know the way of your ship, and how many leagues are to be counted for one degree of Latitude in euerie Rombe whereby you sayle, Chap. 32.

FIRST you haue to vnderstand that in sayling iust North and South, you doe alwaies abide vnder one selfe great Circle called the Meridian, vnder the which, when you haue sayled so farre as the altitude of the Pole is changed one degree, then haue you gone 17 Spanish leagues, and a halfe, & you haue to note that euery Spanish league containeth 2857. fathams, & that our English league containeth no more but 2500. fathams, so as the Spanish League is more than our English League by 357. fathams, & euery fatham containeth 6. foote. Againe in sayling East and West, you doe alwaies remaine vnder one selfe Paralell, by meanes whereof the altitude of the Pole doth

neuer

neuer alter, & therfore no true account can be made of the leagues, but by such meanes as Cognet teacheth in the Chapter following. But if in sayling North and South, you decline one rombe eyther towards the East or West, and goe so farre as the altitude of the Pole is changed by one degrée, then you haue made somewhat more than 17. Spanish Leagues and a halfe, and to bee short, the more rombes that you decline towards the East or west, the more leagues in number doe belong to one degrée of altitude, as you may plainely sée by this figure demonstratiue here following, in which the letter A. signifieth the place or point in the card, from which you depart, situated in the Parallell A, B.



Then suppose C. D. to be another Paralel equally distant from A, B. by one degrée of altitude. Nowe if you sayle right East or West, then you shall alwaies remaine in the Paralell A, B. equally distant from the Pole. But if you saile from A. right North so farre as the altitude of the Pole is augmented one degree, then your Shippe shall be in C. and if you saile by the first rombe towardes the East so far as the Pole doth alter in altitude one degree, then your Ship shall bee in E. and thereby your way must needes bee longer, and so consequently the more rombes you decline from north to East, the longer is your way, and the more leagues must be accounted to one degrée of altitude, as the lines drawne from A. to E. F. G. H. I. K. and D. doe shew. And what so euer is saide here of the quarter from North to East, the same is to be vnderstood in all the other three quarters, that is, from North to West, from South to East, and from South to West. But if you will know how many Leagues doe belong to

euery

euery degrée according to the rombe whereby you saile, then consider well this Table here following.

The first Table.

Rombes.	Leagues.
1	17 $\frac{1}{6}$
2	18 $\frac{4}{15}$
3	21 $\frac{5}{30}$
4	24 $\frac{2}{4}$
5	31 $\frac{1}{3}$
6	45 $\frac{1}{4}$
7	89 $\frac{2}{3}$

For in sayling from North or South, towardes East or West so farre as you come to change one degrée of altitude of the Pole, the saide degree doth require for the first rombe, &c.

Now then to know howe much way you haue made in sayling, you must first know as well the Latitude of the place from which you departed as of that place whereunto you be arriued: then by the foresaid Table seeke to know how manie Leagues doe belong to a degree of that rombe whereby you haue sayled, for in multiplying the number of the leagues by the degrees of the difference of the two Latitudes, the product therof will shew you how many Leagues you haue sayled, notwithstanding sith the way may bee made longer or shorter by changing or shifting of the winde, it is needfull that the Pylot haue consideration thereof, who by skilfull coniecture must sometime eyther adde to, or take fro according as need shall require. Moreouer by the foresaid figure marked with letters, you may also easilie vnderstand how much you change in Longitude, that is to say, how much you are distant from the Meridian of that place from whence you departed, bee it eyther towards the East or West, for he that saileth from the point A. as is aforesaid right North or South, he remaineth alwaies vnder one selfe Meridian: but he that sayleth by the first rombe towards the East or West so farre as he changeth one degree of Altitude, and arriueth to the point E. is now distant from his first Meridian so much as is the space betwixt C. and E. which wee finde by computation to be three leagues and a halfe for one degree of latitude, which amounteth to twelue minutes of a degree, and so of the rest of the rombes, as appeareth by this Table heere following.

For

The second Table.

Rombes	leagues	Degrees and minutes of Longitude.	
first	3 $\frac{1}{2}$	0	12
second	7 $\frac{1}{4}$	0	25
third	11 $\frac{3}{5}$	0	40
fourth	17 $\frac{1}{3}$	1	0
fift	26 $\frac{1}{5}$	1	30
sixt	42 $\frac{1}{4}$	2	25
seuenth	88.0	5	2

For in sayling from North or South towardes East or West so farre as you change one degree of altitude of the Pole, you change also your Meridian, and thereby your Longitude, the quantitie whereof answerable to euery rombe, is set downe on the right side of this Table.

And to make this more plaine by example, suppose that you sayle from Lisbone, which is a famous port in Portingale, by the winde Southwest and by west, which is the fift rombe from south to West, so farre as you finde the altitude of the Pole to be 18. degrees lesse then at Lisbone. Now if you would know how many leagues you haue sayled, and also howe much the Meridian of that place is more westwarde then the Meridian of Lisbone, then doe thus. Looke in the first Table, and you shall finde that to one degree of the fift Rombe doe belong 31. leagues and a halfe, which leagues being multiplyed by 18. doe make in all 582. leagues and $\frac{1}{2}$. which you haue sayled. Then looke in the seconde Table, and you shall finde for the fifth rombe one degree and 30. minutes of Longitude, which being multiplyed by 18. and a halfe, do make 27. degrees and $\frac{1}{2}$. of a degree, for by so much is Lisbone more Eastwarde then the place where you are. And whereas the first Table is made according to the proportion of right lines, such as are commonly drawne in Mariners Cardes, Cogniet maketh another Table according to the proportion of circular lines, which for that it differeth very little or nothing from the first Table, I omit here to set it downe. But nowe because the first Table doth chiefely serue those that saile either East or West in any Parallel betwixt the Equinoctiall and the 60. degree of Latitude or altitude of the Pole: And that from thence forth by reason that they sayle by more oblique and spirall Circles doe make the longer voyage, Cogniet thought good to adde a thirde Table shewing how many leagues bee answerable to one degree of Altitude to those that sayle eyther East or West in any Parallel

paralel that is betwixt the Pole & the 60. degrés of altitude, which Table differeth not much from the others in the four first rombs, but in the three last, that is in the 5. 6. and seuenth rombe it differeth greatly, and most in the seuenth as you may easily perceyue by comparing this and the first Table together.

The third Table.

	Deg.	M		Leagues.	
The first rombe hath	1	1	Which according	17	19/24
the second rombe	1	5	to the proportion	18	21/24
the third rombe	1	12	of 17. leagues & a halfe, for one degree do make for	21	0
the fourth rombe	1	26	euery rombe so	25	1/12
the fift rombe	1	50	many leagues as	32	1/12
the sixt rombe	2	42	this Table sheweth.	47	1/4
the seuenth rombe	5	44		100	1/3

How to account the leagues in sayling directly East or West without changing the latitude or altitude of the Pole.

Chap. 33.

IN sayling right East or West, you continue still in one selfe Parallel without making any change of Latitude. Most men therefore thinke it is impossible for you to make any true account of the leagues but onely by coniecture, for remedie whereof Cogniet hath inuented a rule most certain, as he saith, the foundation wherof is thus: First you must suppose the meridian of that place from whence you depart to be a firme & fixed point, and to be the very beginning of that parallel wherein you sayle, then you must know what houre it is aswell at the place from whence you first departed, as also at the place whervnto you are arriued, & hauing the difference of the houres, you must know how many leagues euery houre yéeldeth according to the parallel of that altitude of the

Pole

pole vnder which you sayle, so shall you easily knowe how many leagues you haue sayled. This foundation being first laid, Cognict setteth downe this generall rule in this manner following: Whensoeuer you haue to saile (sayth he) right East or West, you must first prouide your selfe of these two thinges, the one is of an Astronomicall ring that may iustly shewe the houre at any time: In steade whereof I thinke it better to haue an vniuersall Dyall, such a one as is described by VVilliam Borne in the one and twentieth Chapter of his Regiment: the other thing is to haue a true houre glasse that will run continually foure and twenty houres, and therefore had neede to be three times more long and large then common houre-glasses be, whereof the glasse makers can quickly prouide you, and because the ship leaneth sometime on the one side and sometime on the other, it shall bee needefull to hange the said houre-glasse with ringes of brasse or latten, to the intent that it may alwayes hange leuell like as the Mariners Compasses are wont to be hanged in their boxes. Now being thus prouided of these two instruments, you must at your departing prepare your houre glasse, that is to say, you must set it a running iust at noone when the sunne is right South, not forgetting to turne it in your voyage once a day in the very instant that it is ready to runne out. Then hauing sayled certaine dayes, and being arriued at the place where you would know what way you haue made, looke to your houre glasse, and tarrie vntill it bee full runne out, at which instant seeke to know what houre it is by your Astronomicall ringe, or rather by the vniuersall Dyall, for if you sayle East, you shal find it to be past noone, but if you sayle West, then it will want of noone, and keepe those houres in minde that you may know how much it is more or lesse then noone, for those houres by shewing the difference of the houres, that are betwixt the Meridian of the place from whence you departed, and the Meridian of the place whereto you are arriued, will certifie you with the helpe of this Table here following, what quantitie of way your shippe hath made.

A table

A Table to helpe you to know what way your ship hath made in sayling right East or west without changing your latitude, together with a briefe description and vse thereof.

De. of Latit.	Leagues.	De. of Latit.	Leagues.	De. of Latit.	Leagues.	De. of Latit.	Leagues.
0	262 1/3	23	241 1/3	46	182 1/4	69	94 5/7
1	262 5/12	24	239 3/4	47	179	70	89 1/6
2	262 1/4	25	238	48	175 1/2	71	85 1/2
3	262 1/8	26	236	49	172	72	81
4	262	27	234	50	168 1/3	73	76 2/3
5	261 1/2	28	231 7/8	51	165	74	72 1/2
6	261	29	229 1/2	52	161 1/2	75	68
7	260 1/2	30	227 1/4	53	157	76	63 1/2
8	259 7/8	31	225	54	154 1/4	77	59
9	259	32	222 1/2	55	150 1/2	78	54 1/2
10	258 1/2	33	220 1/4	56	146 2/3	79	50
11	257 1/2	34	217 1/2	57	143	80	45 1/2
12	256 2/3	35	215	58	139	81	41
13	255 3/4	36	212 1/2	59	135	82	36 1/2
14	254 2/3	37	209 3/4	60	131	83	32
15	253 1/2	38	206 7/8	61	127	84	27 1/2
16	252 1/4	39	203 5/6	62	123	85	22 3/4
17	251 1/8	40	201	63	119	86	18 1/8
18	249 2/3	41	198	64	115	87	13 1/4
19	248 1/4	42	195	65	111	88	9 1/4
20	246 3/4	43	192	66	106 1/4	89	4 2/3
21	245	44	188 1/4	67	102 1/2	90	
22	243 1/4	45	185 1/2	68	98 1/4		

This Table as you se consisteth of foure collums, in euery one whereof are set downe on the left hand the degrees of altitude of the Pole, and next to that on the right hande the leagues answerable to euery degree, the vse whereof is thus: First seeke out

in the said Table the degree of altitude belonging to that Parallel vnder which you sayled, and next to that on the right hand you shal find the number of leagues incident to that degree: which number of leagues, if you multiply by the number of houres before found, the product therof wil shew you how many leagues you haue sayled. And if there be any minutes annered to the hours, then multiply also the number of the foresaid leagues found in the Table, by those minutes, & diuide the product thereof by 60. and the quotient shalbe leagues, which you must adde to the former leagues, & the summe therof will shew how many leagues you haue in all sailed.

An example of counting the way of your shippe in sayling right West.

Chapter 35.

SUppose that you haue to sayle from the Cape Saint Vincent in Spaine right West, and therefore you prepare your houre glasse as it may begin to run iust at noone, and hauing sayled 8. or 9. dayes, (not forgetting once euery day to turne your houre-glasse) you do arriue at one of the Iles of the Azores called S. Mary, and there hauing tarryed vntil your houre-glasse be cleane runne out, and seeking to know at that instant by your Astronomicall ring, or by some vniuersall Dyall what houre it is, you finde that it is a 11. of the clocke and 10. minutes past, which wanteth 50. minutes of iust noone, and that is the difference betwixt the two Meridians, that is to say, the Meridian of Cape S. Vincent, and the Meridian of the Ile of S. Mary, both which places being in one selfe Parallel must needes haue one selfe Latitude or altitude, which is 37. degrees, which altitude being found in the Table in the second collum on the left hande, you finde there also hard by it on the right hand 209. leagues and $\frac{1}{4}$. of a league, for euery houre of that Parallel, which number of leagues, if you multiply by the foresaid 50. minutes, the product shalbe 10487. $\frac{1}{2}$. which if you deuide by 60, you shall finde in the quotient 174. leagues and $\frac{9}{24}$. parties of a league, which is the iust quantitie of your whole voyage.

Another example of counting the way of your ship in sayling right East.

Chap. 36.

SUppose then that you haue to sayle from the newe found lande right East in the Parallel of 50. degrees: and hauing caused your hourglasse to beginne to run iust at noone, you set forth and sayle the space of 15. dayes, not forgetting euery day once to turne your houre glasse. Now if at the 15. dayes end, you would know how many leagues you haue sayled, to finde in your Card in what place you are, you must first tarry vntill your houre glasse be cleane runne out, and at that instant séke by your Astronomicall ring, or by some vniuersall Diall, to knowe what houre it is, which because you haue sayled right East, you finde to be two houres and twelue minutes afternoone, then resorting to the Table aforesaid, you finde in the third colum the 50. degrées of altitude, together with the number 168. leagues and a halfe, annexed to the said degrée for one houre of that Parallel, which summe being multiplyed by two houres, maketh 337. leagues, then multiply once againe 168. by the odde 1/2. and deuide the product thereof by 60. so shall you find in the quotient 33. leagues and somewhat more, which being added to the former summe 337. leagues will make in all 370. leagues and a little more, and that is the true quantity of your voyage. And Cogniet saith that by practizing this way of counting, you may knowe euery day, yea euery houre, what way your ship maketh in sayling right East or West.

To know howe much you goe out of your way in sayling by one wrong rombe or by more.

Chap. 37.

IF in sayling to any place you direct your course eyther too high or too low by one rombe you lose in euery 100. leagues 19. leagues and 1/2. of a league, so as you go out of your way almost the fift part of your voyage. And if by two rombes, then in euery hundred leagues you lose 39. leagues, that is to say, you go so far

out of the right way: And if you fall three rombs out of your right course, then in euery hundred leagues you lose 58. leagues: and if you fall foure rombes, then you lose in euery hundred leagues 76. leagues and the more rombes that you mistake in your direction, the more you wander out of your right course. Thus much touching the Mariners Compasse and his Carde: nowe wee will speake of the North starre, and of his guardes, and then of the sunne and of the Moone, and so end.

Of the North starre, otherwise called the Lodestarre, and his guardes, and how to know the same.

Chap. 38.

THough euery Mariner knoweth the North starre so soone as he seeth it in the firmament, because it is his chiefe guide to direct thereby his ship in ỹ night season in all the North parts of the world: yet euery man that is no Sayler knoweth him not, and therefore minding here to treat thereof, I thinke it not amisse first to teach him how to know it, & in what part of the heauen it is placed, and howe far it is distant from the North Pole.

The Poets do faigne that of the 48. Images of the fixed starrs that bee in the heauen, which are otherwise called Constellations, there be two Beares hauing tayles, whereof the one is called the great Beare, and the other the little Beare, in euery of which are seuen principall starrs: And that bright starre which is in the very tippe of the little Beares tayle, is commonly called of our English Mariners the Loadstar, of the Latines Stella polaris, of the Greekes Cinosura, and of the Arabians Alrucuba. But to know this star, you must first find out the seuen starrs of the great Beare by looking towardes the North part of the firmament, of which starrs foure being placed in his body, do make (as it were) a foure square, and the other three starrs being placed in his tayle, which is somewhat rising in the midst, doe represent the portion of a circle, the little Beare hath also the like shape, sauing that her feet & belly do turne vpwardes, so as the tippe of her tayle is answerable to the two hindermost starrs of the great Beare, as you may see in these figures following.

Some do call the great beare great Charles Wain or Wagon, and the little Beare little Charles wain, because in each figure the foure square stars do signifie the four wheels, and the other three stars the 3. horses: Nowe to finde out the Loadestarre, imagine



a right line to passe through the two hindermost starres otherwise called the guardes or pointers of the great Beare, as you see here in this figure, and that line will rightly direct your eye to the Lodestarre which standeth in the tippe of the little Beares tayle, for there is no bright star that can be seene betwixt the two guards of the great Beare and the Lodestarre. Notwithstanding some doe affirme that there is another star nigher vnto the Pole then the foresaid Loadestarre, and that star is as they say no more but 50. minutes distant from the Pole: I haue heard that there is a Priest an Astrologer with the King of Denmarke, who is wont to finde out this starre by the helpe of an instrument whereby hee getteth first the sight of sixe other stars at one instant, which way I feare me is more troublesome then profitable, and if there were any such starre indeed, and therewith so needful and meet to be vsed as is the Lodestar, I doubt not but that some of our learned Pilots would haue founde it out, and also haue had some vse thereof long ere this time. But leauing this matter I will returne to the description of our Mariners common Lodestar, and shew of what bignesse it is: also what Longitude, Latitude, declination, and motion it hath, and finally the chiefest and most necessary vses therof.

This

This ſtarre according to the Ptutenicall Tables is of the thirde bignelle: and hath in Longitude 53. degrées 30. minutes, counting from the firſt ſtarre of the Rams horne, whoſe place in theſe our dayes is in the 27. degrée 30. minutes of Aries, and by this meanes the place or Longitude of the Loadſtarre is in the 21. degrée of Gemini, & his Latitude, counting from the Ecliptique line towardes the North Pole of the Zodiaque is 66. degrées 0. minutes, and his declination counting from the Equinoctiall towardes the North pole of the worlde is 86. ſo as hee is in theſe dayes diſtant from the North pole 4. degrées, ſome ſay 4. degrées and 9. minutes, but Cognier ſayeth, that he is diſtant from the pole but 3. degrées and a halfe, who findeth by the Aſtronomical Tables that this ſtarre at the birth of Chriſt was 12. degrées 36. minutes diſtant from the Pole, and euer ſince hath gone decreaſing, and ſhall decreaſe euery day more then other, vntill it come to be but 26. minutes diſtant from the Pole, which is as nigh as it can approch to the Pole, for then his diſtance ſhall beginne againe to encreaſe. This ſtarre maketh his dayly reuolution from Eaſt to Weſt in 24. houres, as all other ſtarres doe by vertue of the firſt moueable, but his circuite is ſo ſmall, and his gate ſo ſlow, as in the ſpace of 24. houres he goeth not much more then 24. degrées of the Equinoctiall, and in his turning rounde about hee maketh as it were a little Circle, in the middeſt where of is the North pole it ſelfe, which is inuiſible & can not be ſeene.

And though the image or conſtellation of the little Beare containeth many ſtars, yet the ſeuen before mentioned and ſet forth in figure are moſt obſerued, of which ſeuen ſtarres in the little beare, two ſtars called the gards of the North ſtar are to the mariners moſt familiar, for diuers reſpects hereafter declared. And of thoſe gards the one is Northerne & the other Southern, and both are ſaid to be of the ſecond bignelle, & yet the Southerne gard ſeemeth to the eye both leſſer and darker then the other. Of which two ſtars I thinke it not amiſſe to ſet downe here the Longitude, Latitude, and declination as I haue done before of the Loadſtarre.

The Longitude of the South gard is 100. degrées 30. minutes, whereby his place is in the ninth degrée of Leo. And his latitude is 72. dgrées 40. minutes, and his declination is 73. degrées, ſo as he is diſtant from the North pole 17. degrées.

The Longitude of the Noꝛth guarde is 109. degrées, 30. minutes, ſo as his place is in the 20. degrée of Leo, and his Latitude is 74. degrées, 50. minutes, and his declination is 76. degrées, ſo as his diſtance from the Noꝛth Pole is 14. degrées. Thus hauing ſhewed the greatnes, the longitude, the true place, the latitude, and the declination aſwell of the Lodeſtarre, as of his two guardes, I thinke good nowe to ſet downe the chiefeſt vſes that ſeamen haue of them.

The vſes of the North ſtarre, and of his guardes.

Chapter. 39.

THe firſt vſe is to knowe thereby the variation of the Mariners Compaſſe.

The ſecond is to know by his guardes when the Noꝛth ſtarre is aboue oꝛ beneath the Pole.

The thirde is to know by the Noꝛth ſtar and his guardes with the helpe of an inſtrument called a Nocturlabe the houre of the night.

The fourth is to know the eleuation of the Pole. And you haue to note that the Noꝛth ſtarre and his guardes are alwayes aboue our Hoꝛizon, and doe neuer goe downe in any place whereas the Noꝛth Pole hath any eleuation, be it neuer ſo little. But beſides theſe ſtarres there be alſo in this our latitude diuers other images of ſtarres that are alwayes aboue our Hoꝛizon, and doe neuer go downe, as the Dꝛagon, the great Beare, the image of Cepheus, of Caſsiopeia, the image of Auriga, hauing the Goat at his back which is a fayre bright ſtarre of the firſt bigneſſe, and many others which I leaue to name, becauſe I haue heretofoꝛe deſcribed them all at large in my treatiſe of the Globes, by which ſtarres by reaſon that with vs they neuer goe downe, the latitude of any place and alſo the houſe of the night may bee knowne ſo well as by the Lodeſtarre.

But now as touching the vſes of the foꝛeſaide ſtarres beſoꝛe mentioned, the firſt whereof ſhewing how to find out by the Lodeſtarre the variation of the Compaſſe, is taught beſoꝛe in the 25. chapter, accoꝛding to William Bourne his rule ſet downe in his Regi-

Regiment, and as for the other three vses they are plainely taught in the two Chapters next following.

To know by helpe of a little Table made according to the Mariners rule touching the 8. principal rombes, shewing how and when the Lodestarre is eyther aboue or beneath the Pole, that you may knowe thereby the true altitude of the Pole in taking the height of the Lodestarre with your Astrolabe or crosse staffe.

Chapter. 40.

TO know this you must alwaies haue due consideration of the two guards of the little Beare, for when those guardes are iust Southwest from the Lodestarre, then is the Lodestarre at his highest in the very Meridian, and therefore it is right aboue the Pole, and when those guards be iust Northeast from the Lodestar then the Lodestarre is againe in the Meridian at his lowest, and thereby right vnder the Pole, and in both places his distance from the Pole is but three degrees and a halfe, as Cogniet saith: according to which account he setteth downe this Table following.

This Table is deuided into two collums, whereof that on the left hand containeth the eyght principall rombes or windes, and that on the right hande containeth the degrees and minutes of distance of the Lodestarre from the Pole, being eyther aboue or beneath the Pole.

	The rombes or windes.		The degrees and minutes of the declination of the Lodestarre from the Pole.		
If the guards be	West.	Then the Lodestar is	1	½	Aboue the Pole.
	Southwest		3	½ ½	
	South.		3	0	
	Southeast.		1	0	
	———		———		
	———		———		
	East.		1	½	Beneath the Pole.
	Northeast		3	½ ½	
	North		3	0	
	Northwest		1	0	

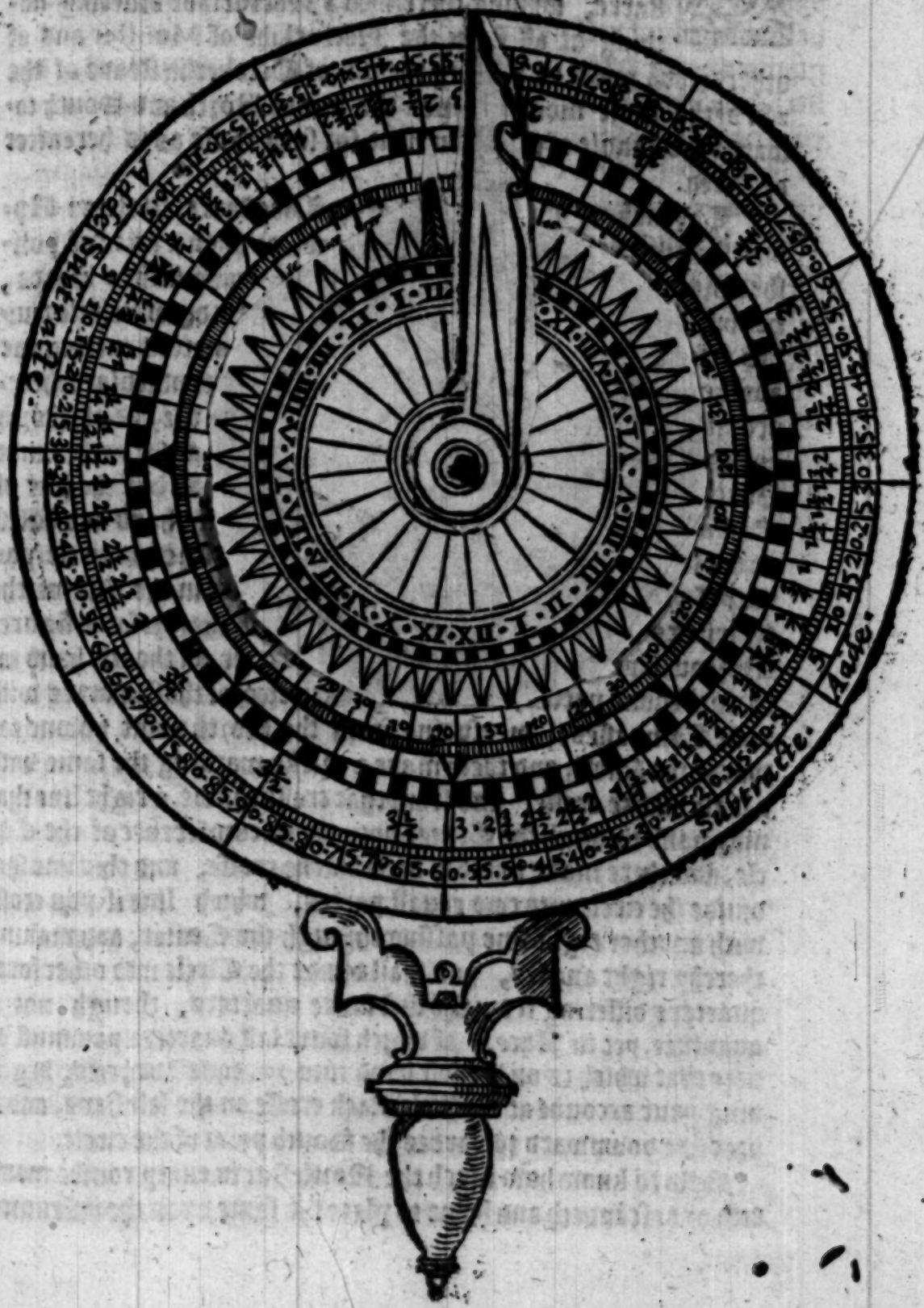
This Table differeth in one point from the Mariners common rule set downe as well by Medina, and by Martin Cortes, as also by William Bourne touching the guards, for they all appoint but halfe a degree of declination of the North starre from the pole, the guardes being eyther in the rombe Southeast, or Northwest, to both which rombes Cogniet appointeth one whole degree of declination. The vse of which table in seeking to know, the elevation of the Pole is thus. First hauing taken with your Astrolabe the altitude of the Loadstarre aboue your Horizon, obserue immediately in which of the 8. former rombes his guardes be. For if they be in any of the 4. vpper rombes of the Table, then you must subtract from the height of the Lodestarre taken with your Astrolabe, so much as is set downe for that rombe in the collum on the right hand of the said table, and the remainder shall be the true altitude of the Pole, but if the guardes be in any of the foure nether rombs, then you must adde so much to the height of the Lodestar, and the summe thereof shall be the altitude of the Pole. But because this table serueth only for the 8. principall winds and for no more. Cogniet therefore setteth downe the making of a twofold instrument, whereby you shal not onely know (as hee saith) how much the Lodestarre is aboue or beneath the Pole in euery other rombe as well as in the 8. principall rombes, but also you shall know thereby the true houre of the night more exactly than the Nocturlabe of Munster or Appian doth shew.

How to make an instrument which wil shew at any houre of the night how much the Lodestar is eyther aboue or beneath the Pole in euery other rombe as well as in the 8. principall rombes, which are only contayned in the former Table, and also the true houre of the night, the shape whereof followeth.

Chapter 41.

The

The shape or figure of the Rectifier of the North Star.



Cogniet calleth this instrument Rectificatorium Stellæ Polaris, that is to say, the Rectifier of the North starre, ioyning thereunto a Nocturlabe differing nothing at all from the Nocturlabe of Munster and of others, but onely in placing the 21. of October in steade of the 28. of the same moneth vppon the line of North and South towards the handle of the instrument for such cause as is hereafter declared.

The making of the rectifier of the Lodestarre, is thus: Vpon a smooth péce of bourde of firme wood, or vpon a péce of polished plate of brasse or Latten being sixe or seuen inches broade, hauing a handle, as you sée in the former figure, draw a circle diuided into 4. quarters by helpe of two crosse diameters cutting one another in the center with right angles, the perpendicular whereof shall signifie the Meridian line, that is to say, the line of North and South, at whose vpper end set North, and at the nether ende South, and the other ouerthwart Diameter shall bee the line of East and West, hauing East marked on the right hand and West on the left hande, and in euery quarter of the foresaid circle you may if you will place the like rombes that are in the Flie of the Mariners Compasse, as you may sée done in the foresaide figure. Moreouer, you must diuide the vpper quarter on the left hand into thrée equall partes, and hauing taken two of those partes with your Compasses, measuring from the North point downe towarde the West, and there make a pricke, marking the same with a little blacke crosse, and from that crosse drawe a right line that may passe through the Center vnto the circumference of the Circle, and there make another little blacke crosse, and this line shal diuide the circle into two equall partes, which line if you crosse with another right line passing through the Center, and making thereby right angles, you shall diuide the Circle into other foure quarters differing from the first foure quarters, though not in quantitie, yet in place, of which foure last quarters you must diuide that which is on the left hand into 90. equall degrées, beginning your account at the little black crosse on the left hand, and so procéede downward towardes the South point of the circle.

Now to know how much the North star in euery rombe mounteth or descendeth and howe to place the same vpon the instrument

so

so as you may know how much to adde to the altitude of the Lodestarre, or to subtract from the same, you must vse this Table following, which Table consisteth of two collums, whereof that on the left hand containeth the degrees and minutes of the declination of the lodestarre, proceeding from one quarter of a degree to another, vntill you come to 3. deg. and a half, which is (as Cogniet saith) the greatest declination of the lodestar, from the Pole: and the other collum on the right hande containeth the degrees & minutes of a quarter or quadrant, diuided by diuers and sundry proportions of numbers into 90. degrees, which proportional degrees and minutes are to bee reckoned in the first quadrant deuided into 90. equal degrees, & next descending from the first crosse on the left hande thus.

The degrees and minutes of the declination of the Lodestarre from the Pole.	The degrees and minutes of the Quadrant, diuided by diuerse portions of numbers into 90. degrees.	
	Deg.	Min.
¼	4	6
½	8	13
¾	12	22
1 0	16	36
1 ¼	20	55
1 ½	25	23
1 ¾	30	0
2 0	34	51
2 ¼	40	0
2 ½	45	35
2 ¾	51	48
3 0	59	0
3 ¼	68	13
3 ½	90	0

First beginning at the saide crosse, and descending downewarde, tell out 4. degrees and 6. minutes, & right against that set downe ¼. then tell in the same quadrant from the saide crosse 8. degrees, and 13. minutes, and right against that set downe ½. and so proceede according as the Table directeth you, vntill you come to 90. against which you must set down 3. deg. & ½. And as this quarter is diuided, so you may deale with the other 3. quarters, and in each of the 3. quarters which are beneath the 2. crosses forget not to write this word Subtract, and in each of the 2. quarters aboue the 2. crosses write this word Ad, as you see in the former figure. Then ther shal want nothing but only a ruler or inder, which must be fastned to the center of the instrument, so as it may bee turned round about a pinne hauing a round hole in it, through which you may see the Lodestar, and also at the same instant by lifting vp and

downe

downe the inder you may see on the outside of the instrument the foreguard of the saide starr appearing euen with the right edge of the inder called Linea fiduciæ, or the fiducial line drawn from the center of the instrument alongst the inner edge of the inder, and so is the instrument for that purpose fully perfected. But if you wold ad thereunto a nocturlabe, then you must draw vpon the center thereof diuers circles next to the space containing the winds, and the spaces betwixt those circles must be some wider, and some narrower: For the first vpper space must bee narrow, containing the dayes of euery moneth, & the next space somwhat wider, containing the number of those daies set down in Arithmetical figures, and the third space wider then that, containing the names of the moneths thē next to the lowest circle of the nethermost space place a little rundle fastened to the instrument with the foresaid hollowe pin, so as it may turn round about the same. And this rundle must be diuided into 24. hours, that is to say, 12. for the day, & 12. for the night, which rundle wold be made with teeth, whereof one must be longer than all his fellows signifying alwaies the 12. houre of the night, which is alwaies to be laide vpon the day of the moneth wherein you seeke to know the houre of the night. And remember in distributing the daies of the moneth, that you alwaies set the 21 day of October beneath towardes the handle in the very line of North & South passing right through the middest of the handle, so shall the instrument shewe the houre of the night more truely then when the 28. day of October standeth beneath vpon the line of South and North, as it doth in the common Nocturlabes, the makers whereof had respect to the Pole it selfe which is inuisible, and not to the North starr which is apparant to the eye, by means whereof the guards of the Lodestarre sometime do shew sooner or latter by 7. degrées and 18. minutes, if you count from the Pole, which is almost halfe an houre difference, and for that cause also Cognet maketh his account in his foresaide rectifier to beginne at the little black crosse, seuen degrées more forward then it ought to doe, if he should count from the Pole, and not from the North starre.

How

How to know by the foresaid twofolde instrument as well the mounting and descending of the North starre, as the true houre of the night both at one instant, and also the eleuation of the Pole.

Chapter. 42.

FIrst then hauing laide and staied the great tooth of the moueable rundle marked with 12. vppon the day of the moneth wherein you seeke, and holding the instrument by the handle with your one hand right before your face, leaue not to put that hand forward from you, or to bring it backwardes towardes you, vntill you may see with the one eye, winking with the other, the North starre through the hole of the pin, which is in the center of the Instrument: and so soone as you see the North starre, list with your other hand the inder vp and downe vntill you see also at that instant the North guarde of the Lodestar on the outside of the instrument appearing euen with the fiuetiall line or inward edge of the said inder. Then staying the inder there, looke vpon what houre it falleth, for that shall be the houre of the night. And looke also at that instant vppon what degree of distance it falleth in the outermost border of the instrument, wherein those degrees are set downe together with these wordes adde and subtract. For from the point marked with a little blacke crosse nigh vnto the North-west descending through the nether moyetie or halfe deale of the instrument vntill you come to the other blacke crosse, placed nigh vnto the Southeast, the North starre is alwaies aboue the Pole so much as the inder sheweth, which you must alwaies subtract from the height of the North starre to knowe the eleuation of the Pole, hauing first taken with your Astrolabe the height of the North starre. But if the inder do fal vpon any degree or part of a degree in the vpper moyetie or halfe deale of the instrument then to knowe the eleuation of the Pole, you must adde so much as the inder sheweth vnto the altitude of the Lodestarre, as the wordes Adde & Subtract written in the outermost border of the instrument doe plainely shew.

But now if you would know at any houre of the day or night

in what rombe the foresaide guardes be without seeing them and also how much the Lodestarre is declined from the Pole, you nede doe no more but to lay the great tooth of the moueable rundle vpon the day of the moneth, and then to bring the inder vnto the houre which you require, and the saide inder will shewe in the border of the instrument in what rombe the guardes be, and howe much the Northstarre is aboue or beneath the Pole.

I haue found by often triall that this instrument will shew the true houre of the night, and also in what rombe the guardes bee, and thirdly, how much the Northstarre is at any time eyther aboue or beneath the Pole, and by adding the degrees of distance founde in the limbe of the instrument, or by subtracting the same according to the rule before giuen from that altitude of the Northstar, which I haue before taken with my Astrolabe, I haue found at all times the true eleuation of the Pole wheresoeuer I haue made triall thereof. But sith other Starres may perhaps appeare when the Northstarre with his guardes shall bee hidden, I would wish all carefull Mariners to acquaint themselues with as many bright stars as they can, and especially with those which do both rise and set, and also to learne by some Table the declination of euery such Starre, and whether it be Southernly or Northernly, for by taking the Meridian altitude of any such Starre, and by adding to, or by taking from the Altitude thereof, his declination according as the same declination is either Northernly or Southernly (for if it bee Northernly, then you must subtract his declination, and if it bee Southernly, you must adde the same to the altitude of the Starre) you shall finde thereby the altitude of the Equinoctiall, which being taken out of 90. the remainder will shewe the eleuation of the Pole. The meetest Starres for this purpose in these our Northparts of the world are these, Hircus the Goate, Canis minor, the little Dogge, Canis maior, the great Dogge, Dexter humerus Orionis, the right shoulder of Orion. Cingulum Orionis, the girdle of Orion. Cor Leonis, the Lyons hart. Bubulcus, the Beareward. Spica Virginis, the wheat eare in the hand of Virgo. Aquila volans, the flying Eagle. Caput Andromedæ, the head of Andromeda. Ras Argol, the head of Medusa. Oculus Tauri, the Buls eye, and diuers others.

And

And in any case consider whether the declination of the starre be greater or lesser then his Meridian altitude, for if his declination be greater then his Meridian altitude as of those starrs which are nigh the Pole, then you must take his Meridian altitude with your Astrolabe at two seuerall times, that is to say, when he is at his highest in the meridian, and also when he is at the lowest pointe of the same Meridian called the depression, and hauing added those Meridian altitudes together take halfe therof, and that half shall be the eleuation of the Pole, which way of finding out the eleuation of the Pole is nothing meet for a Mariner that is vnder sayle. But now to proceede according to Cogniet his direction in this matter, hee saith, that if in sayling you approch so nigh vnto the Equinoctiall as the eleuation of the Pole is not aboue 17. degrées, then the guardes are not so easily séene, wherefore it shall be néedeful to take some other starre whereby you may both know the houre of the night, and also how much the Lodestarre is either aboue or beneath the Pole, and Cogniet thinketh none of the starres more meete for that purpose then one of these two, that is, eyther the Star called Caput Medusæ, that is the heade of Medusa called of the Arabians, Ras Algol, or else the Starre called Hircus, that is the Goat, both which are fayre bright Starres and of the first bignesse: and the cause why he appointeth the heade of Medusa, is for that this starre is directly opposite to the former guarde, in such sort as this Starre is alwayes aboue the Horizon, when both the guardes are vnder the Horizon. Wherefore hauing prepared your instrument, that is to say, hauing layde the longest tooth of the moueable rundle vppon the day of the moneth wherein you séeke, and hauing found out thereby in such order as is before taught, the north star and also the star called the head of Medusa, both at one instant, marke where the inder falleth, and immediately turne the inder from that poynte to the poynt opposite, abating twelue houres, and so the Inder shall shewe you three thinges at once. First, the rombe wherein the guardes are at that present. Secondly, the houre of the night. And thirdly howe much the North starre is aboue or beneath the Pole. But because this starre is not knowne perhaps to all Mariners, Cogniet would haue you to take the other bright Starre called Hircus, which (as he sayth) goeth 9. houres and ½ before the guardes, in such

sort

sort, as when the former guarde is East, you shall find this Star, counting from the North starre, to be Northwest, and almost 45. degrees distant from the Pole, with which starre if you worke, as you did before with the head of Medusa, sauing that you shall not neede to turne the index vnto the opposite point, but onely to rebate from the point on which it falleth 9. houres and ½. you shall know all the three thinges last mentioned. And this rule (as hee saith) is so generall as you may haue your desire by working in like manner with any other starre that is to you certainly known, and is at that time aboue the horizon.

What starres are obserued by those that sayle beyonde the Equinoctiall line vnder the South Pole.

Chapter 43.

THe ancient Astronomers, as Ptolomey, Timochares, Hypparchus and others did neuer describe any Starre to be more nigh vnto the South pole, then that which is called Canopus, which is a fayre bright starre of the first bignesse, and according to the Tables of Copernicus, is distant from the South pole 38 degrees, and ¼. But those that haue sayled in the South seas of later dayes, haue found out other starres vnknowne to the ancient Astronomers, which are much nearer vnto the said Pole. For Albericus Vesputius writeth of three Starres, making together a Triangle Orthogonall, that is to say, hauing one right angle, now called the southerne Triangle, the middle Star whereof is distant from the South Pole 9. degrees, ⅔.

There be also lately founde out diuers images of other starres nigh vnto ỳ South pole, as that which is called Noah his Doue, or Pigeon, and another called Polophilax, made in the shape of a man, whose longitude and latitude hath not as yet beene rightly set downe by any that I haue read.

But the sea men of these present dayes doe most commonly obserue foure great stars which according to the shape and forme therof they call the Crosse, imagining the greatest Starre of the foure to be the foot, & that which standeth right ouer him, to be the head of the crosse, & the other two to be the 2. arms: and when they

se that the head doeth directlye answere the foote, then they saye that the foote of the saide crosse is right aboue the Pole, and distant from the same 30. degrées. Therfore hauing taken the altitude or height of that starre aboue ỹ Horizõ with their Astrolabe they substract 30. degrees from that altitude, and the remainder is the eleuation of the Pole. Medina in his fift booke & eleuenth chapter setteth downe the shape of the foresaide crosse in this manner.



And he saith that these starres are neither anie of those starres that are appointed to the twelue Signes in the Zodiaque, nor yet any of the 36. Images or constellations that bee in heauen. Moreouer he saith, that in taking the altitude of the great Starre called the foote being in his right place, that is to say, when hee is directly opposite to the head, and that you finde his altitude to be 30. degrées, then you may assure your selfe that you are right vpon the Equinoctiall. And if you find his altitude to be more than 30. degrées, then you are past the Equinoctiall towardes the South Pole. But if you finde it to be lesse than 30. degrées, then you are still on the North side of the Equinoctiall.

Besides the starres aboue mentioned, our Mariners in these North partes of the worlde are woont to obserue diuers other starres, to the number of 32. whose longitude and declination together with their bignesse and also when they rise and set, and when they are mounted to the Meridian, that is to say, are iust South, is plainely set forth by Tables collected of purpose out of the Astronomicall Tables by William Boorne, which Tables you shall finde in the 20. Chapter of his booke called the regiment of the sea. And Robert Norman doeth also set downe the like tables in his booke called the Attractiue, & therefore I thinke it superfluous to repeat the same againe here, & specially sith I haue described vnto you all the starres that be in the firmament that were knowne to the ancient Astronomers, and haue shewed you how to find out by the Globe their longitudes, their latitudes, their declination;

nations their greatnes and all other accidents belonging to the Starres in my treatise of the Celestiall Globe, which I wrote of purpose to further yong seamen.

The knowledge of the stars serueth seamen chiefly to knowe thereby the latitude of any place, and also to knowe the houre of the night: and thirdlie, to coniecture by their manner of rising and setting, and other their aspects what weather is like to follow either foule or faire: the rules whereof to teach truely, belongeth to Astronomers, yet many seamen by dilligent obseruation do attaine to right good iudgement therein. Wherefore leauing to speake any further of the Starres, I wil now briefly speake of the Sunne and of his motions, of his rising and setting in euerie latitude, and of his declination from the Equinoctiall, and of other his like apparances. I say here briefly, because I haue already spoken of him at large in the 1. part of my spheare whereas I treat of the Zodiaque.

Of the sunne, and of his motion, and of the chiefest apparances belonging to him.

Chap. 44.

The Sunne according to the mooning of the first mooueable which is from East to West maketh his dayly reuolution in 24. houres, as all other Starres doe, but according to his owne motion, which is from West to East in going through the twelue Signes of the Zodiaque he spendeth a whole yeare, for his dayly mooning vpon his owne center, called the excentrick, because it is out of the center of the world, is little more then 59. minutes, 8. seconds, making thereby the whole yeare to consist of 365. dayes, fiue houres 49. minutes, 8. seconds, 19 thirds, 37, fourthes, 24. fiftes: and this is called of Copernicus, the equall tropical yeare, which taketh his beginning from the first point of Aries, otherwise called the Vernall Equinore, into which point the Sunne entreth not euerie yeare at one selfe daye of the moneth, for sometime hee entreth into that point the tenth day, and sometime the eleuenth daye of march, which

which day of his entring is alwaies truly set downe in euery Ephemerides, and because the beginning of the tropicall yeare is so vncertaine, the Astronomers do make their yeare called the syderall yeare, to begin at the former star of the Rams horne, & therby doe make the yere to consist of 365. daies, 6. houres, 9. minutes, and 39. seconds, according to which yeare they alwaies rectifie or bring to equality, aswell the equall as the vnequall tropicall yere, of both which I haue spoken in the first part of my Spheare, the 38. and 39. Chapters.

Moreouer, the Sun hath three motions, that is, slow, swift and meane. His slow motion is when he is in the point called Auge or Apogeon, which is a point imagined to be nigh vnto the outermost edge of the Circle which carrieth the body of the Sun called Deferens Solis, and is furthest distant from the center of the world, which point in these our daies is in the 9. degree of Cancer, or there abouts. And being in that point, he goeth little more than 57. minutes in 24. houres. Againe, his swift motion is whē he is in the opposite point to the Auge, called Perigeon, which point in these daies is in the 9. degree of Capricorne, and being in this point, hee goeth one whole degree and almost two minutes in 24. houres, which is almost fiue minutes more than he maketh in his slow motion. His meane motion is when he is in the midst betwixt the two foresaid points, whereas in 24, houres he goeth one whole degree and somewhat more than 2. minutes. And these three sundry motions doe cause the Equinoctial points not to be of equall distance. For the Sun spendeth 7. daies and somewhat more in going from the Equinore of March, to the Equinore of September, than he doth in going from the Equinore of September to the Equinore of March. For if in this present yeare 1592. which is leape yeare, you count the daies from the Vernall Equinore, which is the eleuenth of March, vnto the Autumne Equinore, which is the 13. of September, you shall finde the number of the daies to be 186. and the other number from the 13. of September to the eleuenth of March, to be but 180. which is lesse than the first number by 6. daies, and if it were not leape yeare the difference would be seuen daies, because that February in the leape yeare hath 29. daies.

It is necessary that sea men haue some vnderstanding of the

thes foresaid motions to the intent that they may the better know the true place of the Sunne and thereby his true declination. And note that no calculation of his declination can continue without errour aboue twentie foure yeares. For as often as the leape yeare commeth about, which is euery foure yeares, the Sunne is vpon the Equinoctiall sooner by halfe an houre. But as for the true place of the Sunne, and especially euery day at noontide, the Ephemerides doth most truely shew, and hauing his place, you shall easily finde his declination by this Table following, which will serue for these twentie yeares and more, the like whereof, together with the vse of the same is set downe in the first part of my Spheare the 13. Chapter.

A Table

A Table shewing the declination of the Sunne euerie day throughout the yeare, and the vse thereof.

Chapter. 45.

Degrees of the signes	♈ ♎ D	M	S	♉ ♍ D	M	S	♊ ♐ D	M	S	Degrees of the Signes
1	0	23	53	11	50	6	20	22	57	29
2	0	47	46	12	10	56	20	35	7	28
3	1	11	39	12	31	34	20	46	55	27
4	1	35	30	12	51	59	20	58	20	26
5	1	59	20	13	12	12	21	9	21	25
6	2	23	8	13	32	12	21	19	59	24
7	2	46	54	13	51	58	21	20	13	23
8	3	10	37	14	11	30	21	40	3	22
9	3	34	18	14	30	48	21	49	29	21
10	3	57	53	14	49	51	21	58	29	20
11	4	21	28	15	8	40	22	7	6	19
12	4	44	57	15	27	13	22	15	17	18
13	5	8	22	15	45	30	22	23	3	17
14	5	31	42	16	3	32	22	30	24	16
15	5	54	57	16	21	17	22	37	19	15
16	6	18	6	16	38	44	22	43	48	14
17	6	41	9	16	55	55	22	49	50	13
18	7	4	6	17	12	48	22	55	27	12
19	7	26	57	17	29	23	23	0	38	11
20	7	49	40	17	45	40	23	5	22	10
21	8	12	16	18	1	39	23	9	39	9
22	8	34	45	18	17	18	23	13	29	8
23	8	57	5	18	32	37	23	16	53	7
24	9	16	16	18	47	38	23	19	50	6
25	9	41	19	19	2	18	33	22	19	5
26	10	3	12	19	16	37	23	24	22	4
27	10	24	56	19	30	36	23	25	57	3
28	10	46	30	19	44	14	23	27	5	2
29	11	7	42	19	57	30	23	27	46	1
30	11	29	5	20	10	25	23	28	9	0
	♍ ♓			♌ ♒			♋ ♑			

THe vse of this Table is thus: If the Sunne be in any of the signes set downe in the front of the table, then seeke his degree (first found by the Ephemerides) in the left collum, the degrees whereof doe descend from one to 30. and the square Angle answerable to that signe and degree wil shew his declination. But if the sun be in any of the signes that are in the foot of the Table, then seeke his degree in the right collum, the degrees whereof doe ascend, and the square Angle answerable to that signe and degree wil shew his declination.

There be other thinges also meet for Seamen to know touching the Sunne, as these: First to knowe the foure seasons of the yeare, secondly to know by his declination, the length of both the day and the night in euery latitude, and how it doth encrease and decrease. Item to know in what rombe or winde, and at what houre hee riseth and setteth, and also his meridian altitude, that is, when he is right South euery day, to finde out by the help of that, and by knowing his declination, the true Latitude of any place, & by his shadow to know the houre of the day, which are two chiefe points that the mariner hath most need to knowe. Of all which thinges I minde here to treat both plainely and briefely.

Of the foure seasons of the yeare, that is Spring time, Summer, fall of the leafe, called otherwise Autumne, and winter. Chap. 46.

IN this our Clime the Spring is said to begin when the Sun entreth into the first point of Aries, which is about the 11 of March and continueth vnto the last point of Gemini, which time is said to be hotte and moist, and therefore is likened to childhood: And Sommer beginneth when the Sun entereth into the first point of Cancer, which is about the 12 or 13 of June, and endeth when he is in the last degree of Virgo: and this time is said to bee hotte and drie, and therefore is likened to Adolescencie. Then Autumne or fall of the leafe beginneth when the Sunne entreth into the first point of Libra, which is about the 13 or 14 of September, and endeth when the Sunne is in the last degree of Sagittarius and this time

time is saide to bee colde and drie, and therefore is likened to Manhood: Finally, Winter beginneth when the Sunne entereth into the first point of Capricorne, and endeth when he is in the last degree of Pisces: and this time is saide to bee colde and moyst, and therefore is likened to old age: notwithstanding Galen in his first booke de Elementis saith, that the spring is temperately hot and moyst, & therfore a most holsome time: And Sommer is more hot than colde, and more dry than moist, and therfore is saide to bee hot and dry: And Autumne is also saide to bee dry because it is more dry then moyst, and yet neither hot nor colde, but unequally mixt, and thereby infective and causing sicknesse. And Winter is saide to be colde and moist, not because it is colder or moyster then any other season, but because that in Winter moysture exceedeth dryness, & coldnes exceedeth heate. But you haue to understand that these foure seasons haue not like qualities in all the fiue Zones: For in the burnt Zone, and specially to those that dwell right vnder the Equinoctial, the Sunne beeing in Aries or Libra, causeth greatest heat, and thereby two Sommers, because he is then right ouer their heads, and being in eyther of the Solstices, that is in the beginning of Cancer or Capricorne he causeth 2. winters, because he is then furthest from thē, as I haue declared vnto you in the second part of my treatise of the Sphеare the 20. chapter, whereas I treat of the seasons and shadowes incident to diuers Climes and Paralels whereunto I refer you, and so I end with this matter.

How to know when the Sunne riseth and setteth in euerie latitude, and thereby the length of the day and night, and also in what rombe or winde he riseth and setteth, and how much he declineth euery day from the Equinoctiall eyther Northward or Southward. Also howe to know the eleuation of the pole, otherwise called the latitude of any place, by knowing the Meridian altitude of the Sunne, and his declination.

Chap. 47.

The most part of al these thinges haue beene taught before in my Sphеare, in my treatise of the Globes, and also in my treatise of the Astrolabes. And in the first two treatises I shew also how to finde out the Longi-

tude of any place, and therefore needeth not here to bee rehearsed: But if you would know how to handle the declination of the Sun being vpon the Sea, then read 7.8.9. and 10. chapters of William Borne his booke called the Regiment of the Sea, and you shal be fully instructed therein: The whole effect of all which Chapters Robert Norman setteth downe in few wordes in his newe Attractiue in this manner as followeth.

First learne whether the Sun haue south declination or north declination, which you shall know by his being in any of the Northerne or Southerne signes: Then mark what shadow he casteth, and whether it striketh towardes the Pole whereunto hee is nearest, or to the contrarie. For if the Sunne casteth his shadowe the same way that he is from the Equinoctiall, hee shalbe betwixt you and the Equinoctiall, & then hauing taken his Meridian altitude, subtract the same from 90. & adde vnto the remainder the sunnes declination for that day, and the summe thereof shall be the elevation of the Pole or the distance of your Zenith from the Equinoctiall otherwise called the latitude which is alwaies equal to the elevation of the Pole: But if the Sunne casteth his shadow to the contrary side of the Equinoctial, that is to say, beeing in his north declination casteth his shadow Southward, or being in his South declination casteth his shadow Northward, then eyther the Equinoctiall shal be betwixt you and the Sun, or you in the Equinoctiall, or els you shall be betwixt the Equinoctial and the sun, which you shall know thus: Adde the declination of the sun for that day wherein you seeke vnto his Meridian altitude, and if the summe of the addition be lesser than 90 degrées, then so much as it wanteth of 90 degrées shall you be distant frō the Equinoctiall on that side on which the shadow stréketh: but if it amounteth iust to 90. degrées, then you shall be right vnder the Equinoctiall. Againe if it be more than 90. degrees, then so much as is the ouerplus, so much shall you be from the Equinoctiall towards the Sunne, at which time you shall be also betwixt the Equinoctial and the sun. And if you finde the Meridian altitude of the Sun to be euen with your Zenith, then looke what declination the Sunne hath at that instant, and so much shall you bee from the Equinoctiall on that side wherein the sunne is: But if the Sunne hath no declination, then shall you be right vnder the Equinoctiall line.

Of

Of the shadow of the Sunne, and how to know thereby the houre of the day in any latitude by helpe of an vniuersall Diall.

Chap. 48

My former order nowe requireth that I should speake somewhat of the shadow of the Sunne, and of the diuersitie thereof, according to the Clime or paralell vnder which you saile. But for so much as I haue shewed you in the second part of my Sphere frō the 20 to the 27 chapter of the same, what diuerse shadowes the Sunne yeeldeth in diuerse Climes and Paralels, and also haue shewed what Vmbra recta and Vmbra versa is in the 40 Chapter of my Treatise of the Astrolabes: I minde not here therefore to make a new recitall thereof, but onely to shewe howe you shall finde by his shadow the true houre of the day in euery Latitude by a generall Dyall, made to serue in all Latitudes, of which Dyals, though I haue seene diuerse and of diuerse shapes, yet none liketh me better then that which William Borne setteth downe in his regiment the 21 Chapter, and calleth it the Equinoctiall Dyall, which serueth not onely to know the houre of the day by the shadow of the Sun, but also the houre of the night by the shadow of the Moone when she shineth cleare, which Dyall beeing of small charge, I would wish all Mariners to haue: The making and vse whereof is so plainly set downe by himselfe in the fore said chapter as I thinke it superfluous to set it downe againe here. And thus ending with the sunne, I will now turne my pen to the Moone.

Of the Moone and of all her diuers motions.

Chap. 49.

The Moone is a round thicke and darke body, hauing no light of her selfe, but onely such as shee receiueth from the sunne, and shee maketh her daylie motion from east to west as all other starres do in 24 houres according to the mooning of the Primum mobile, But according to her owne motion, which is from West to East, she goeth but 13 degrees 12 minutes in the space of 24 houres,

and

and that is according to her meane motion. And shee passeth thorough the twelue signes of the Zodiaque in 27. dayes and eight houres: during which time the sun by his naturall motion which is also from West to East, is remoued from the place of coniunction almost 27. degrées, so as the Moone not finding the Sunne there, spendeth two dayes, foure houres, & 44. minutes more in ouertaking him, which being added to 27. dayes and 8. houres, doe make in al 29. dayes 12. houres and 44. minutes. Notwithstanding by reason that the Moone hath aswell as the Sunne three motions, that is, swift, meane, and slow, shée may change sometime sooner and sometimes later then in 29. dayes, 12. houres 44 minutes, and yet one change counted with an other shall make vppe the selfe same summe. And note that this her threefold motion dependeth vpon two points, the one called the Auge, and the other the point opposite to the Auge.

The point Auge of the Moone is when she is furthest distant from the earth, and the point opposite to that is when she is nigheest to the earth: for when she is in the point Auge she goeth little more then twelue degrees in 24 houres: but whē she is in the opposite point, she goeth almost 15 degrées in 24. houres. And in her meane motion which is in the middest betwixt the two foresaid pontes, she goeth 13 degrees and 12 minutes in 24. houres.

Nowe because the Mariners doe account the mouing of the Moone by the points of their Compasses, they may thereby vnderstand that she goeth not alwaies in 24. houres one point and three minutes as they reckon, but sometime more and sometime lesse: For when she is in her slow motion, she goeth little more thē 12. degrées in 24. houres, in which time the sunne goeth one degrée, so as the Moone is distant from the Sunne but 11. degrees, which is but 44 minutes of an houre, which wanteth 4. minutes of a whole point, whereto is attributed 4′8. as hath beene said before: and in her swift motion she goeth 15 degrées, in which time the sunne goeth one degrée, so as she is distant from the sunne 14 degrees, which is more than a point and three minutes of the cōpasse. And you haue to note, that the point Auge of the Moone is moueable and passeth through the Zodiaque in the space of 19 yeares, and thereby sometime causeth the full of the Moone to happen sooner or later.

How

How to know in what signe the point Auge of the Moone is in any yeare.

Chap. 50.

IF you would know in what signe the Auge of the Moone is in any yeare, then you must consider the prime or Golden number of that yeare, for when the prime or golden number is one, then her Auge is in Aries. And if the Moone be also then in Aries, she is in her slow motion: & beeing in the point opposite which is ♎, she is in her swift motion. And sith this Auge of the moone goeth through the twelue signes in 19. yeres, as hath beene said, it must needes fall out that in 9. yeares & a halfe her Auge commeth to be in Libra: And then the Moone being there shee is in her slow motion: And being in the point opposite, which is Aries, she is in her swift motion. Againe when the prime is 5. then her point Auge is in Cancer: & the Moone beeing there shee is in her slowe motion, and when shee commeth to bee in the point opposite which is Capricorne, shee is in her swift motion: And when the prime is 14 or 15. then her point Auge is in Capricorne, where if the Moone bee also, then shee is in her slowe motion: and being in the point opposite which is Cancer, shee is in her swift motion. And note when the Moone is in her swift motion, she maketh her change or full, or any other aspect the later: And contrariwise when she is in her slow motion, she maketh her change, or ful, or any other aspect the later. Howeuer you shall se her at the time of her change, either sooner or later, according to the time of the yere, for from Januarie to June you shall se her within 24 houres after her change because she hath during those moneths North declination from the Sunne, & maketh a greater arch then the Sunne doth. But from Julie to December you shall not se the Moone scant three dayes after the change. But you may se her within 24. houres before her change, because that during those moneths she hath South declination from the Sunne. And note that when the Moone is three dayes and 18 houres, which is the halfe quarter of the moone, the Seamen doe call that time the prime day, because the moone is then 4 points to the Eastward of the sun, which is three houres, for to euery point is attributed

three

three quarters of an houre as hath béne said before. Moreouer it is necessarie for seamen to know when the Moone riseth & setteth, and in what part of the Horizon in euery Latitude: and how long she shineth and when she is full south, and also what Latitude shee hath, and whether it be South or North euery day and houre throughout the yere. All which thinges are most easie to be found by the Globe, and by help of the Ephemerides in such sorte as is before taught in my treatise of the Globes, and also by help of M. Blagraue his Astrolabe, her true place in the Zodiaque beeing first knowne by the Ephemerides. It is meet also to knowe when she is in Coniunction with the sunne, or at the full, and the rest of her quarters, which is easily knowne by the Ephemerides.

When the Moone is saide to bee in Coniunction with the Sunne, or to be at the full, and what her greatest latitude is as well from the Eclitique line, as from the Equinoctiall.

Chap. 51.

SHe is said to be in coniunction with the Sun when the sunne and she bee both in one selfe signe and like degrée: But when she is at the full, then shee is opposite to the sunne, and distant from him 6. signes, which is the one halfe of the Zodiaque, containing 180 degrees: And in euery quarter she is distant from the sunne three signes which is 60 degrees: Moreouer the Moone is saide to haue latitude both Northerne and Southerne from the Eclitique line, which line the differēt of the moone crosseth in 2 points, and thereby maketh two intersections, whereof the one tending towards the North is called the head of the Dragon, and the other intersection towardes the South is called the taile of the Dragon, so as when the Moone is passed 90. degrees from the Dragons head towards the North, then her Latitude is fiue degrees Northward: And when she is distant 90 degrees from the taile of the Dragon towardes the South, then her Latitude is also 5. degrees Southward, which is the greatest Latitude that she hath on eyther side of the Eclipticque line, whereof I haue written more at large in the first part of my speare the 15 chap-

in

in which you shall finde a figure representing the saide Dragon both head and tayle: But her Latitude is to be considered in two respects, that is not onely from the Ecliptique line, but also from the Equinoctiall, for from the Ecliptique line her greatest Latitude is but 5. degrées on eyther side of the Ecliptique, as hath bin said before. But from the Equinoctiall her greatest Latitude is 28. degrées and a halfe on either side of the Equinoctiall. which in mine opinion might be more rightly called her greatest declination, which exceedeth by 5. degrées the declination of the sunne, for that is but 23. degrées and a halfe, or rather 28. on either side of the Equinoctiall. But this great Latitude of the Moone is onely to be vnderstood when the prime is one, and that her Auge is in Aries: For when the prime is betwixte 9. or 10. yéres or more, the Moone declineth not from the Equinoctial on either side aboue 18. degrées and a halfe at the most.

How to know in what part of thé Zodiaque the head of the Dragon is euery yeere.

Chap. 52.

IF you would know in what part of the Zodiaque the head of the Dragon is, then you must consider the prime, for when the Prime is one then the Dragons heade is in the first point of Aries, euen as the point Auge is. And in 19. yeares it passeth thorough the twelue signes, aswel as the point Auge of the Moone, but with contrary course: for the point Auge of the Moone moueth according to the succession of the signes, that is, from Aries to Taurus, Gemini and so forth: but the head of the Dragon hath a contrary motion, that is, from Aries to Pisces, and so into Aquarius and so forth, so as in 9. yeares and a halfe it méeteth iust with the point Auge of the Moone in the signe Libra. Thus you see that by knowing thē prime, you learne also to knowe in what signe the Auge of the Moone, and also the Dragons heade is, and what Latitude the Moone hath, aswell from the Ecliptique line as from the Equinoctiall. But one of the chiefest points to be had by the Moone, is to know thereby the tides, that is when the sea floweth and ebbeth in any place: whereof we come now to speake.

How

How to know the tydes in any place by the Moone.

Chap. 53.

BEfore that you enter into any Hauen or Riuer, it is necessarie to knowe the true tydes of that place, which tydes are subiect to the motion of the Moone, for she causeth at one place or other alwaies in one certaine rombe full Sea. As for example, it is alwaies full Sea at Antvverpe when the Moone is either right East or West: and it is eb or low water there when she is North or South, and because the Moone doth passe through all the rombes of the Mariners Compasse in 24. houres, they allow to euery rombe $\frac{1}{4}$. of an houre, which is 45. minutes, and that being multiplyed by 32. doe make iust 24. houres, wherefore if the two rombes, North and South do yéld each of them 12. houres, then the first rombe must nédes yélde $\frac{1}{4}$. of an houre, the second one houre & $\frac{1}{2}$. and the third two houres and $\frac{1}{4}$. and so forth of the rest: For by adding to euery rombe $\frac{1}{4}$. you shall finde that the East and West doe yélde alwaies 6. houres: but then you must note that according to the age of the Moone the tydes doe fall euery day later and later, wherefore to know the true time of the tide in any place, you must first learne by some Rutter or by the relation of others that can tell in what rombe the Moone causeth full sea in that place, and then at what houre it is full sea, the Moone being either in the change or at the full, which you shall know by allowing to euery rombe $\frac{1}{4}$. of an houre in such maner as is before set downe. But if you would know at what houre it is full sea in that place euery day, then you must first vnderstand that the moone in 30. daies slacketh 24. houres, which amounteth to $\frac{4}{5}$. of an houre which is 48. minutes for euery day, for so much she declineth euery day from the Sun, then looke how many daies the Moone is olde, and hauing multiplyed the same by $\frac{4}{5}$. that is to say by 48. minutes, adde the product thereof to those houres at which it is full sea, and you shall haue the true time of full sea euery day. As for example, suppose that it was full sea at the last newe Moone at some place heere in

England

England at three of the clock in the afternoone, and now I would know at what a clocke it shall be full sea 5. daies after the newe Moone. Now if you multiply 5. being the age of the Moone by 48. minutes, and adde to the product thereof three houres, which was the time of the last change, the full sea shall be at that place at seuen of the clocke. But if the summe of such addition be aboue 12. houres, then you must cast away the 12. and the remainder shall shew you the true houre of full sea.

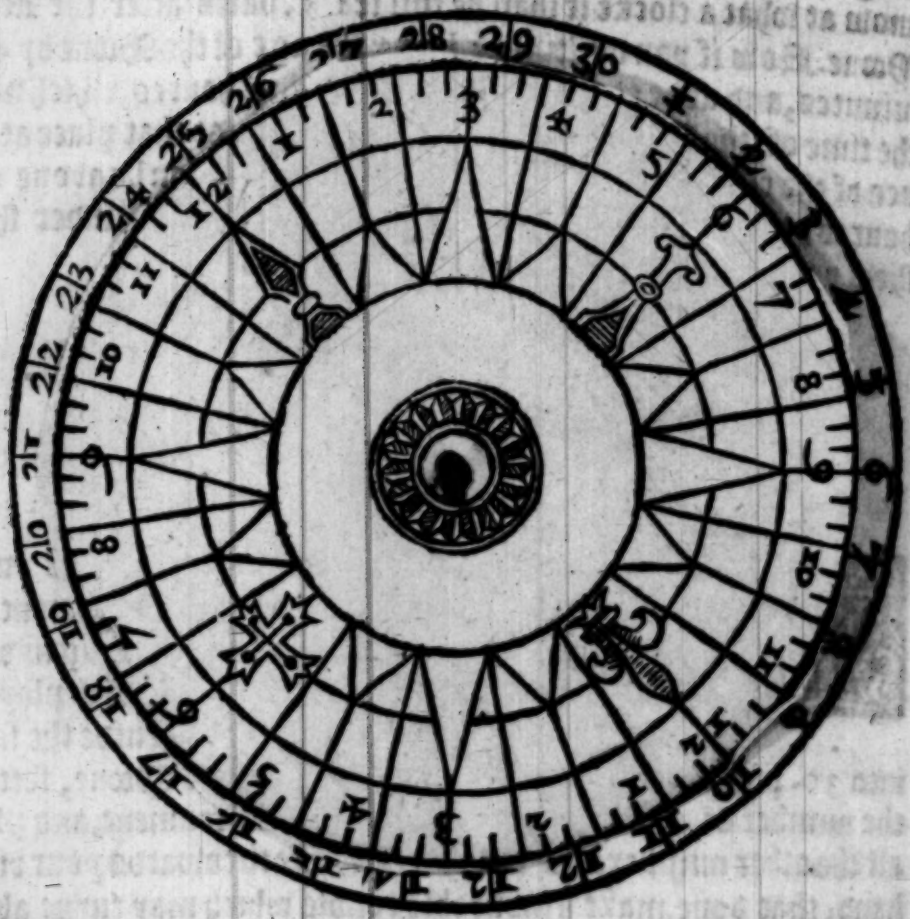
Hovv to knovv by helpe of an instrument the tydes at any place.

Chap. 54.

There is also an easier way to knowe the tides euery day in any place by the helpe of an Instrument set downe by Cognet, whereof both the making and vse here followeth. First vpon some board well playned and made smoothe, draw a circle, and deuide the same into 30. partes signifying the daies of age of the Moone, setting the number of 30. aboue in the toppe of the instrument, and place all the other numbers as 1. 2. 3. and so forth towards your right hand; that done, make a moueable rondle which may turne about within the verdge of the first Circle, & deuide that into 24. hours, and also into 32. rombes, setting the North point marked with the Flower deluce at the twelfth houre aboue, & the South point at the twelfth houre beneath, and the East point at the sixth houre on your right hand, and the West point at the sixth houre on your lefte hande, & so shall your instrument be perfect, the vse whereof is thus:

First you must know what rombe or winde of the moone in that place which you seeke maketh a ful sea, & also the age of the moone by some Almanack or some other rule before taught, then hauing these two things turne the inward rondle of the houres & rombes vntill the foresaid knowne rombe doth iustly answere to the 30. day of the great rondle, and there staying it firme with your finger, seeke in the outermost border of the greater rondle the age of the Moone, and that will shew you in the rondle of houres the very houre of full sea that day in that place.

But



But one chiefe thing touching the knowing of the tydes is to be noted as Borne sayth, which is that the sea will flow more by one point of the Compasse in the spring tydes, then in any of the quarters of the Moone called Nep tydes in euery riuer that hath any indraft, and is of some reasonable distance from the Sea: As for example, it floweth at Graues end at the change or full of the Moone when she is South Southwest: but in any of her quarters it skant floweth when she is South and by west, and this rule as he saith is generall for euer.

How

How a generall Rutter shewing the tydes in all places should be made.

Chap. 55.

WIlliam Borne doth set downe what Moone doth make a full sea, as well heere in the most partes of our English coastes as in some other parts of France and Spaine, and so do many others whose Tables touching the tydes are called Rutters, wherof some are truely set downe and some are false: But sith such Rutters doe serue but for a few particular places, I would wish that some learned Pilot that hath sayled many and sundrie long voyages, to make a generall Rutter that might serue for all places if it were possible, or at the least for so many places as are knowne in these daies: And I would wish such general Rutter to be made in maner of an Alphabet: and that euery place might haue his true Longitude and Latitude added thereunto, to the intent that euery place might be the more easily found out in any Map or Carde that is graduated with degrées of Longitude and Latitude: And then to shewe what Moone doth make a full sea in euery such place, which thing whosoeuer would performe, he should in mine opinion deserue great commendation. And thus I end this Treatise, praying al the learned Seamen not to be offended or greéued with me for that I do make young Gentlemen our own Countrimen partakers of their most worthy knowledge, wherof the ignorant are not able to iudge nor to yéelde them that praise which they deserue: yea rather I hope they will helpe to perfect whatsoeuer I haue herein left vnperfected, to make the young Gentlemen the more skilfull, & therby the more seruiceable to their Countrie, and in so doing they shall procure to themselues great good will and infinite thankes.

A BRIEFE DES-

cription of vniuerſall Maps and Cards, *and of their vſe, and alſo the vſe of* Ptolo-

mey his Tables together with the true order of making the ſaide Tables, and of all other Mappes and Cardes aswell vniuerſall as particular, and that according to the doctrine of the beſt Geographers that be or haue beene in theſe latter daies.

LONDON

Printed by *Iohn Windet*. 1597.

LONDON

Printed by John Wolfe. 1597.

TO THE RIGHT

Worshipfull M. *Francis Windam*, one of the Iudges of her Maiesties Court of Common Pleas.

GOod Sir, vouchsafe to receiue this poore little Pamphlet, partly as in lieu of a richer New-yeares gift, and partly as a token of my thankful mind, which is more willing then able to deserue any one iotte of the great fauour, friendship, and diuers benefites that I haue from time to time receiued at your hands: for want of which abilitie I neither can, nor will loosen my selfe from any of those bonds; wherewith you haue most straightly bound me, but rather to increse the same, humbly praying you to continue in your good loue and fauour towardes me, vntill I shall willingly deserue the contrarie: In the meane time I pray God to prosper you in all your doings, and long to preserue you.

From my poore Swans nest. 17. December. 1588.

Your olde welwiller, bound to be alwaies at your commaundement.

Thomas Blundeuil.

To the Reader.

I Dayly see many that delight to looke on Mappes, & can point to England, France, Germanie, & to the East and West Indies, and to diuers other places therein described: but yet for want of skill in Geographie, they know not with what manner of lines they are traced, nor what those lines doe signifie, nor yet the true vse of Mappes in deede: Wherefore, somewhat to instruct those that haue not studied Geographie (without the knowledge whereof me thinkes that the necessarie reading of Histories is halfe lame, and is neither so pleasant, nor so profitable as otherwise it woulde be) I thought good to write this little Treatise: in reading whereof, if you reape any profit thereby, I pray you be thankfull to the Right Worshipfull, & my speciall good friend M. Frances Windam, one of the Iudges of her Maiesties Court of Common Pleas, who first motioned me thereunto, and by whose perswasion I haue the more willingly put the same in Print.

Vale.

Certaine

Certaine Termes of Cosmographie, *briefly expounded, for those that are not* learned in that Science, to the intent they may the better vnderstand this Treatise.

THe Axletree of the world is a right line, imagined to passe through the Center or midst of the earth, from the one ende of heauen to the other: the vpper end of which Axletree is called the Pole Arctike, that is to say, the North Pole: & the nether end, the Pole Antarctike, that is, the South Pole: vpon which two Poles, otherwise called the hookes or hengils of the world, the heauens doe turne rounde about the earth, and this Axletree signifieth also the first Meridian. Moreouer the Cosmographers doe deuide the world into diuers parts by certaine Circles, whereof some are called greater, and some lesser. The Axletree of the world. The two Poles.

The greater are those which doe deuide the world into two equall parts: whereof there be sixe: that is, the Equinoctiall, the Zodiake, the Meridian, the Horizon, and the two Colures. The greater Circle

The Equinoctiall is a great Circle, gieding the world in the verie midst betwixt the two Poles, by reason whereof there are 2 Latitudes, the one Northern, and the other Southerne. The Equinoctiall.

The Northerne Latitude is that space, which is contained betwixt the Equinoctiall and the North Pole. The North Latitude

The Southerne Latitude is that space, which is contained betwixt the Equinoctiall and the South Pole, and either of these The South Latitude

two spaces containeth in breadth 90. degrées.

A degrée is one part of a Circle, being deuided into 360. parts called degrées.

Again, the circuit of the Equinoctial, containing 360. degrées, is the very Longitude of the earth: the first degrée of which Longitude beginneth at the first Meridian, placed in the West, and so proceedeth Eastward vnto the 180. degrée of the Equinoctial, and from thence returneth by the West vntill you come againe to the 360. degrée, which is the last degrée of Longitude. And note by the way that euery degrée of the Equinoctiall containeth 60. English miles, so as the Longitude of the whole earth is 21600. miles.

The Zodiake is a great, broade, and slope, or shoring Circle, carrying the 12. signes: in the middest wherof is a line called the Eclipticke line, from which the Sunne neuer swarueth.

The Meridian is a great Circle, passing ouer our heads, in what part of the world so euer we bee, and also through both the Poles: which line when the Sunne toucheth it aboue the Horizon, it is noonetide or midday to those that dwell vnder the same.

The Horizon is a great Circle, deuiding the vpper halfe of the world which we see, from the nether halfe which we see not: in the very middest or Center of which Circle, if in a plaine fielde you looke round about you, you shall alwaies find your selfe to be.

Now as touching the two Colures, because they differ not in effect, though in name, from two Meridians, I leaue to speake of them, as well for that I haue spoken of thē at large in my Sphere, as also for that they are not mentioned in this Treatise.

Of the lesser Circles there be foure: that is, the two Polar circles, and the two Tropikes. Of the two polar Circles, the one enuironeth the North pole, and therefore is called the Circle Articke, and the other enuironeth the South Pole, and is called the Circle Antarticke, because it is opposite to the other.

Againe, of the two Tropiques, the one is placed betwixt the Equinoctiall and the Circle Articke, and is called the Tropike of Cancer; and the other is placed betwixt the Equinoctiall and the Circle Antarticke, and is called the Tropike of Capricorne: and each of these Tropikes is distant from the Equinoctiall 23. degrée

grées and a halfe, which is the greatest declination of the Sunne from the Equinoctiall, for hee neuer mounteth higher then the Tropique of Cancer, nor descendeth lower then the Tropike of Capricorne, and these two Circles are Paralels to the Equinoctiall.

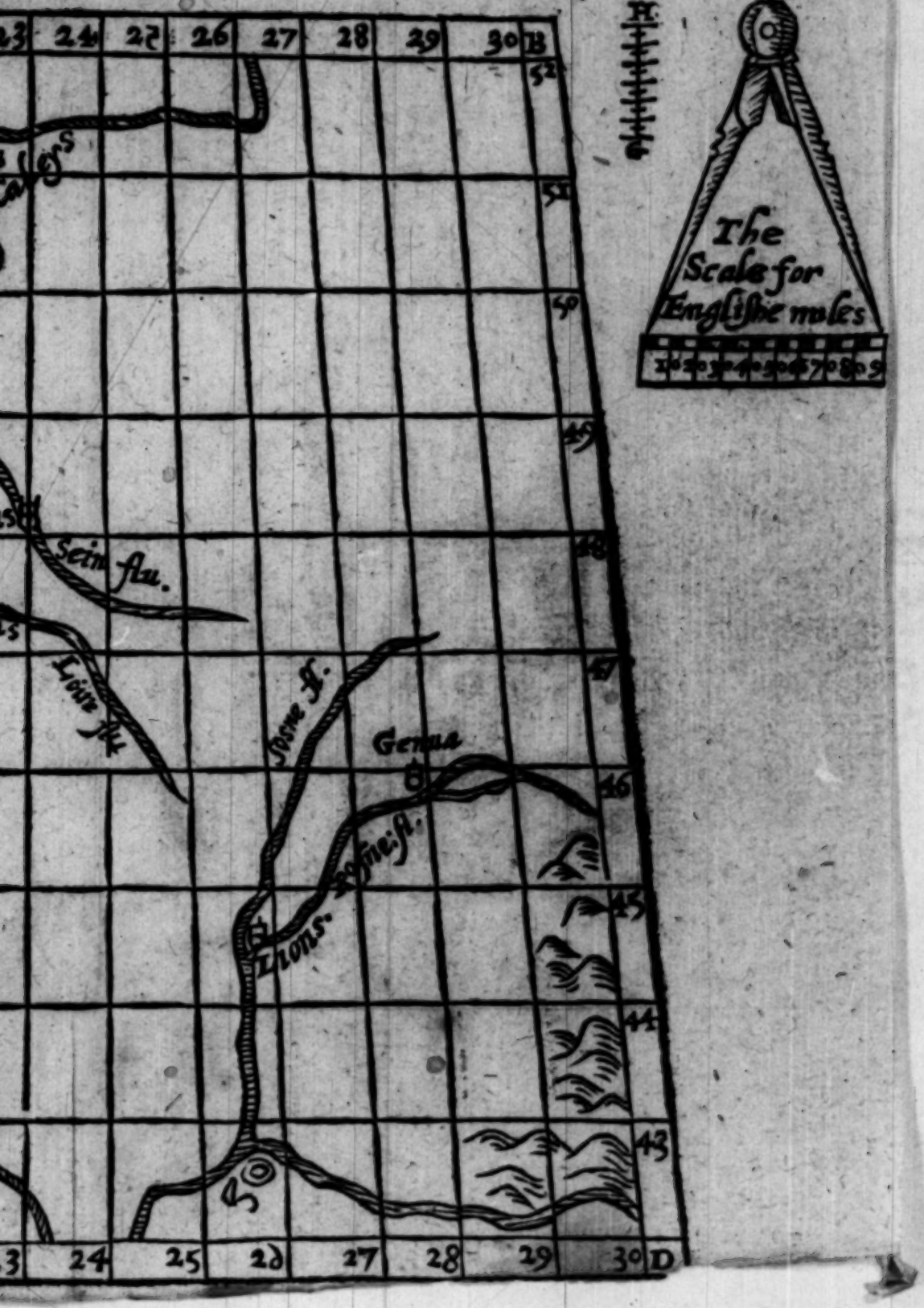
Paralels are two lines or Circles, equally distant in all places one from another. And by these foure lesser Circles the earth is deuided into fiue Zones or broade spaces, whereof there be two cold, two temperate, and one hotte, described both in my Sphere and also in this Treatise.

A Paralell of the longest day, is a space of the Earth, wherein the day increaseth by one quarter of an houre, proceeding from the Equinoctiall towards any of the Poles.

A Clime is a space of the earth, containing two such Paralels wherein the day increaseth by halfe an houre, of which Climes according to the olde writers, there bee seuen declared at the full in my Sphere, and also somewhat touched in this Treatise.

The Map of


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The
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Englishe miles

The Map of

A BRIEFE DEScription of vniuerſall Mappes and *Cardes, and of their vſe, and alſo* the vſe of Ptolomey his Tables.



THis word Mappa in Latine ſignifieth a Tablecloath of lynnen to couer a boarde: of the ſhape and likeneſſe whereof vniuerſall Tables, containing the deſcription of the earth, are commonly called Mappes. And firſt you haue to vnderſtand, that euery ſuch Map is chiefly traced with two ſorts of lines or Circles, that is Meridians and paralels. The Meridians are either right or circular lines paſſing through both the Poles of the world, and are imagined to be drawne right vp and downe from the head to the foote of the Map, and are called Meridians, of this Latine word Meridies, which is as much to ſay as midday or nowntide. Becauſe that when the Sunne commeth to touch any of thoſe lines, it is midday to thoſe that dwell right vnder the ſame. Againe, paralels are either right or circular lines imagined to be equally diſtant one from another which doe croſſe the foreſaid Meridians with right angls. Now in the verie midſt of the Map is moſt commonly drawne from head to foote a right line

line which signifieth not only the first Meridian, but also the Axle-tree of the world, the vpper end of which line is called the Pole Artique, that is to say, the North pole, and the neather end, the pole Antartique, that is the South pole, and this line is crossed in the very midst betwixt the two poles with another great Circle or right line called the Equinoctiall, because that when the Sunne commeth to touch this line or Circle, the day and night is equall throghout the world. The one halfe of which line toward the right hand sheweth the East part, and the other halfe towards the left hand sheweth the West part of the world: so as these two lines, the first Meridian and the Equinoctiall doe point out the 4. quarters of the world, North, South, East, and West, from whence the 4. principall winds doe blow, betwixt which winds are set downe in most Maps together with their Latine or Italian names in the outermost skirt or border thereof 8. other winds, so as in all there be 12. winds, whereby the ancient Grekes and Romanes were wont to saile. The names whereof both Greke, Latine and English are heretofore set downe in the later end of my Sphere.

But now to returne to our first two lines, that is, the first Meridian and the Equinoctial, you haue to note that both these lines or Circles are deuided each of them into 360. degrés, so as euery quarter of them containeth 90. degrés. And in the Equinoctiall are set downe the degrés of Longitude, which is the length of the world, round about from west to East, and againe from East by West home againe: The first degré whereof beginneth, wher as the first a foresaid Meridian crosseth the Equinoctiall in the very middest of the Map, & so procœdeth Eastward vnto the number of 180. degrés, which is as farre as you can goe Eastward, sith from thence by reason of the roundnes of the Earth, you must nœds turne backe againe Westward vntill you come to the 360. degré, which is the last degré of longitude, and endeth where the first degré beginneth.

Moreouer in the said first Meridian, or in some other Meridian hard by it, are set down the degrés of Latitude, that is to say, the breadth of the world, both Northern and Southerne: for from the Equinoctiall to the North Pole are contained in the foresaid Meridian 90. degrés, and that is called the North Latitude, and

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from the Equinoctiall to the South Pole, are contayned in the said Meridian, other 90. degrées, which is called the South latitude: and in most Maps the Equinoctiall line is diuided & crossed with 18. Meridians on each side of the first Meridian, deuiding the Equinoctiall into 36. seueral spaces or distances, euery space contayning 10. degrées, & euery degrée contayneth 60. Italian miles of length.

Moreouer betwixt the Equinoctiall and each of the Poles are drawen certaine circles or lines, called (as I said before) Parallels: of which most commonly 4. are painted with red inke, signifying the 4. lesser Circles before described in my Sphere, whereof the highest towardes the North Pole, is called a Circle Artique, being distant from the Pole 23. degrées and a halfe, & the lowest towards the South Pole is called the Circle Antarctique, being also distant from the Pole 23. degrées and a halfe: or rather 23. degrées 2″8. for that is the greatest declination of the Sunne at this present.

Now as touching the other two red Circles, the one lying betwixt the Circle Artique and the Equinoctiall, is called the Tropique of Cancer, and the other lying betwixt the Equinoctial and the Circle Antarctique, is called the Tropique of Capricorne, & each of these two Tropiques is distant from the Equinoctiall 23. degrées and 2′8. which is the greatest declination of the Sunne, for betwixt these two Tropiques the Sunne continually maketh his course and returne, as this word Tropique signifieth, mounting neuer higher then the Tropique of Cancer: nor descending lower then the Tropique of Capricorne: for which cause some doe set downe in their Maps betwixt the saide two Tropiques an ouerthwart line, signifying the Ecliptique line, vnder which the Sun continually walketh. Now by helpe of the foresaid foure Circles the earth is deuided into 5. Zones, that is, one horte, 2. temperate, and 2. cold. The horte is contained betwixt the 2. Tropiques, in the midst of which horte Zone, is the Equinoctiall line, and of the 2. temperate Zones, the one lieth betwixt the Tropique of Cancer and the Circle Artique, and the other betwixt the Tropique of Capricorne and the Circle Antarctique.

Againe, of the 2. colde Zones, the one lyeth betwixt the North Pole and the Circle Artique, and the other betwixt the South Pole, and the Circle Antarctique. Nowe besides these fower

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speciall Paralels, there be diuers other Paralels drawne vnder ech side of the Equinoctiall both Northward and Southward, which crossing in certaine poines the first Meridian marked with degrées, doe shew the true Latitude of euery place, and vnder what Clime or Paralel it is, and also how many houres the longest day of any place vnder euery Paralel is, beginning to accompte the same, either from the Equinoctiall vpward towards the north pole, alongst the first Meridian marked with degrees of Northern Latitude, or else from the said Equinoctiall downward towards the South pole, marked with degrées of Southerne Latitude.

Notwithstanding, they vse most commonly to set downe the number and iust distances of the Climes, Paralels, and howers in the North latitude onely, willing the like numbers of Climes, Paralels, and howers to be accompted in the South Latitude, euen as they are in the North Latitude and with like distances. And note that in proceeding towards the pole from the Paralel, wheras the longest day is 24. houres, they accompt the Paralel of the longest day no longer by houres, but by moneths, that is to say, from one moneth to six monethes, whereof wee haue spoken before in our Sphere. The numbers of the foresaid Climes, Paralels and houres you shall finde set forth in Vopellius Map alongst the first Meridian on the left hand. But hee setteth downe the numbers of the longest daies encreasing by months in the vttermost border of his Map on the right hand betwixt the North pole, and the Circle Artique. And in that border he setteth downe the number of leagues and miles answerable to euery Paralel, whereas also he sheweth the three differences of Inhabitants according to their shadows, that is to say, the Periscii, Heteroscii, and Amphiscii.

Vopellius his Mappes

Periscii are those that dwell in any of the two colde Zones, whose shadow goeth round about them.

Heteroscii bee those that dwell in any of the two temperate Zones whose shadow tendeth at noontime but one way, that is either North or South.

Amphiscii be those that inhabite the hotte Zone, whose shadow tendeth both wates, that is sometime North and sometime South, as is before declared at large in my Sphere.

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But in the Map of Gemma Frizius, you shall find all these things set forth on the left hand of his Map amongest the vtermost Circles, whereas vpon the Circle Artique, he setteth down the twelue signes, hauing certaine compalled lines, running downe to the Equinoctiall, meeting & concurring all in one point: at the end whereof vpon the Equinoctiall, you shall find the number of howers, at which the Sunne riseth in euery degree of Latitude. The Mappe of Gemma Frizius.

Also at the nether ende of his Map on the left hand, he placeth a halfe quadrant, which he calleth Directorium nauticum, wher of we shall speake hereafter.

And because he would haue his Map to serue both sea and land, he setteth downe a certaine number of Mariners Compasses deuided with 32. lines signifying the 32. windes, which doe shew how euery place beareth one from the other, and by what winde a Shippe is to be directed from one part to another, which thing is also obserued in Mercators Map and others that haue written more lately, and yet nothing seruiceable for the Sea, because (as M. Borough, Controller of her Maiesties Nauie, a man most skilfull in the Art of sailing saith) no consideration is had in the said Maps or Cardes touching the variation of the Compasse, without the which they can neuer set downe any true or iust direction.

Now as touching the diuision and order of the partes of the Earth, most commonly described in vniuersall Maps, you shall vnderstand that the ancient Cosmographers, not knowing then the West Indies, nor many other places situated both Northward and Southward (which haue beene since discouered) deuided the whole Earth onely into three partes, that is, Europe Aphrike and Asia, in the description whereof, their Mappes neuer extended in Latitude Northwardes further then to 63. degrees, as I haue said before in my Sphere, and Southward no further then to 16. degrees of Southerne Latitude, or there about, but in Longitude from West to East, beginning the same at the Ilands called Insulæ Canariæ or Fortunatæ, which are situated at the West end of Aphrike, in the Sea called Mare Atlanticum: their descriptions doe extend to 180. degrees. But because a whole

worlde almost hath beene found out since those times, our moderne Cosmographers do deuide the whole earth into foure parts: that is Europe, Aphrike, Asia and America, which we now call the West Indies. And because men of diuers Nations haue sayled round about the worlde, East and West, their late descriptions doe extend in Longitude the whole content of the Equinoctiall, which is 360. degrées: and in Latitude Northwards, the same descriptions doe extend to 80. degrées: and Southwards to 66. ½ as you may see in the vniuersall Mappes lately set forth by Mercator, and by Barnardus Puteanus and others.

The Map of Mercator and of Barnardus Puteanus.

But the ancient and moderne doe greatly differ in the diuision of the parts of Latitude, as well Northerne as Southerne, and also in Longitude: for, whereas the ancient Cosmographers doe deuide each Latitude into 90. degrees by certaine Paralels making 9. equall spaces, euery space containing 10. equall degrees: in the latter Mappes last mentioned, you shall finde those spaces and the degrees thereof altogether vnequall, the first three spaces next the Equinoctiall onely excepted, for those differ not aboue one halfe degree at the most: but from thence Northward, euery space is greater then other, and euery degrée in euery such space is greater then other, in so much as the fourth space containeth 11. degrées and a halfe of those degrées which are set downe in the first space, and the fift space containeth of such degrées 13. degrées ¼, the 6. space containeth of the said degrées 16 degrées ¼ the seuenth containeth of the same degrées 23. degrées ½, so as that space is twise so broad as the first space and one halfe degrée more: the eight space containeth of the said first degrées 36. further then which 8. spaces containing 80. degrées of Latitude, their Mappes extend not Northward: and they obserue the like proportion in the Southerne Latitude, sauing that they extend no farther Southward then to 66. degrées and a halfe.

Againe, they differ in Longitude thus: for the moderne Cosmographers do make the first Meridian to passe through the Iles called Azores, which doe stand 5. degrées more Westward then the Fortunate Ilands: through which Fortunate Ilands, Ptolomey and his followers doe appoint the first Meridian to passe.

The cause of which transposing the saide first Meridian is, because that the Mariners Compasse doth neuer shew the right

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North, and South, in any other place, but onely vnder that Meridian. Yea M. Borough thinketh that it would shewe it more truely, if the said Meridian were placed somewhat more Westward. But in those Cardes and Maps that are made according to the rules of Ptolomey: the spaces of Paralels containing the 90 degrees of latitude, both Northward and Southward, are equall, and all the degrees of euery such space, are also equall. And yet the spaces of Paralels that shew the longest day in any place, are toward the Pole, euerie one more narrow than other: for as I haue said before in my sphere, there are 3 kinds of paralels, that is, Paralels of the Sunne, Paralels of the latitude, and Paralels of the longest day. The cause why in these latter Maps, the degrees of latitude are made greater and greater towardes the Poles, are set downe by Barnardus in his vniuersall Mappe, who sayeth there that in making the said Map, he had 3. speciall cares: First, that the places might bee so situates, as they may haue both true direction & distance, & also due longitude and latitude, & as nigh as may be, the same verie shape which they haue in the sphere or globe, to which end he hath inuented a newe proportion or habitude of the Meridians to the paralels, affirming that the Maps before made, are not fit for Nauigation, by reason of the crookednes and bowing of the Meridians, which by their oblique and ouerthwart falling into the Paralels, do so much disfigure in the vttermost parts, the true shape of the Regions, as they can scant be knowne. And as for the Mariners Cardes, because their Paralels of latitude are also of equall distance from the Equinoctiall to the very Pole: he saith that they must needes misfashion the Regions, and make the directions, distances, longitudes, and latitudes to bee vntrue, and thereby cause great errors. Which to auoide, he maketh the spaces of his Paralels and degrees of latitude to encrease by little and little towardes the Pole, affirming that thereby all places shall haue their true shape and also their true directions, distances, longitudes, and latitudes.

His second care was, that the Regions and places might haue their true quantitie & greatnes, and also true distance one from another, wherin he hath taken as he saith, greatest paines whilest

he diu conferre the Cartes and Tables of the Castilians & Portugales aswell amongst themselues, as with diuers other Nauigations both printed and written. His third care was to shewe what partes of the worlde were knowne to the ancient men, that the limits and boundes of their Geographie might not bee vnknowen, to the intent they might haue their due honour & praise. And hauing shewed what places they did in their time describe both East, West, North, and South, in the end of his speech, he affirmeth, that the auncient Cosmographers haue set downe in the East Indyes, more places than euer the Portugales haue as yet discouered or attained vnto.

This Barnardus Puteanus borne in Bruges, is by his owne confession a Cutter or Grauer in brasse, & also a Cosmographer, whose Mappe set forth in the yeare of our Lord 1579. doth not differ in any one poinct that I can finde from the last vniuersall Mappe of Mercator that famous Cosmographer, who as I vnderstand was himselfe also sometime a Cutter and Grauer of such Mappes and Globes as Gemma Frizius did cause to bee printed in his time, from whome Mercator learned great part of his most excellent skill in Cosmographie.

Truely when I did first behold these latter Mappes, and saw that the Paralels towards the Pole were as long as the very Equinoctiall it selfe, it seemed to mee somewhat strange, for then I said, that a Ship in sayling about the worlde vnder the Paralell of 60. degrees, should by this meanes make as long a voyage as that which sayleth about the worlde right vnder the Equinoctiall, which voyage is twice as long. For this containeth in longitude 21600 miles, which is the whole compasse of the earth, and thother containeth in longitude 10800 myles, which is iust halfe so much & no more, But after I had taken better aduisement thereof, I found by measuring with my Compasse, that one degree of the Meridian next to the 60 degree of latitude, did comprehend two of such degrees, as are set downe in the Equinoctiall, & that one degree of the Meridian, crossing the Paralel that hath 70 degrees of latitude, did comprehend 3 degrees of the Equinoctiall line, and so I found the degrees towards the Pole, to ware greater and greater, by which degrees I perceiued their meaning was

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to haue the longitude of their paralels to bee measured, and not by the degrees of the Equinoctiall. And by that meanes their paralels should haue each one as nigh as might be his due longitude proportionally, euen as they haue in the Globe.

Moreouer the shape, quantities, and distances of such countries as haue beene found out of late dayes, must needes bee more perfectly set forth in these Mappes, then in those that haue beene made heretofore, because the true longitudes, & latitudes of those places were not so well knowne then as they are now. Albeit I feare me that of many places in the Indies, there are as yet but few true longitudes knowne. For it is not so easie a thing to get the true longitude of euery place, as the true latitude thereof. And had not the late makers of Mappes beene greatly holpen by the Maps and Cardes of such learned Pilots as haue trauailed those countries, I doubt not, but that they should haue committed as great errours as those that wrote before them. And of one thing I doe assure my selfe, that in these latter Mappes, more places are described, then euer were knowne or discouered: as for example, the North parts of Groyneland, Crockland, & America, all which they make Ilandes, and yet neuer sayled about them, and specially on the North side, as it may well be gathered by the vayne attempting of diuers Nations, to finde out newe waies in the North seas to the Molucas both by East and West. For being a little entered into those seas, they are quickly driuen backe, either by extreame cold, by great Yse, or by the raging floudes bred of snowe, & falling from the mountaines of the next continent, & making in some places such whirlepooles in the sea, as if any ship chance to come nigh them, it is soone swallowed vp. Neyther doe I thinke, that King Arthur in his time euer sent (as it is reported) any of his people to inhabite those Ilands, being places in mine opinion, more meet for Whales and monstrous fishes to dwell in, then for men: and specially for English men, which are not able to suffer the cold winter at Wardhouse: to which place some of our Mariners do sayle in sommer seasō euery yeare. And yet Wardhouse hath scant in latitude seuenty one degrees, much lesse then are they able to Winter in those places that haue seauentie seauen degrees of latitude, as the North side of Groynland and Crockland hath. Moreouer the

K. Arthur.

Northside of the promontorie. Tabin hath 76 degrees of latitude which place, whatsoeuer Plinie saith thereof in his fourth Booke of Histories, yet I beleeue that no Roman came euer there to describe the Promontory. Neyther doe I beleeue that the Frier of Oxford, by vertue of his Art Magicke, euer came so nigh the Pole to measure with his Astrolabie those cold partes together with the foure floudes, which Mercator and Bernardus doe describe both in the front, and also in the nether end of their Maps, vnlesse hee had some cold deuill out of the middle Region of the aire to be his guide. And therefore I take them in mine opinion to be meere fables. Truely if any men should discouer those parts, me thinketh that the people of Finmarke and of Wardhouse or such like people bordering vpon the North Seas, should best doe it, hauing bodies vsed to extreame cold. But then beeing bred in so grosse an aire, their wits perhaps are too grosse for such a purpose.

The Frier of Oxford.

I remember that William Boorne in his booke called the Regiment of the Sea, setteth downe fiue sundrie waies to saile into Cathay, whereof the first way is by the Cape of good hope in the outermost South part of Africke: The second by the Sea called Mare Magellanicum: The third way is to saile betwixt the North part of America and the Iles of Groynland and Crocland: The fourth is by Noua Zemla, whereas Sir Hugh Willoughbie in seeking that way was frozen to death. The fift waie is to saile right vnder the Pole, that is, first from South to north, vntill you be right vnder the Pole, and then from North to south, alleadging there certaine reasons to proue the 3 last waies possible to be as passable, as the first 2 waies well knowne in these daies and vsually haunted.

The strongest reason that Boorne vseth to make the foresaide Seas Nauigable, is, for that the Sunne by his long tarrying aboue the Horizon, so warmeth both land and sea, as it cannot bee ouer soone cold againe. But I pray you what heate can the sunne yeelo to that place aboue whose horizon he is neuer elevated more then 23. degrees and a halfe, a verycold winterly heat God wot. And though the cold were not so extreame as I take it to bee indeed, yet in desert places, where is there any safe harbour, fresh-

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water or any other necessary succor to be had. For in taking such a iournie, let no man thinke to goe through without a bait, vnles he saile in Pegasus, and hath both wind and tide at will.

Notwithstanding, I can greatly commend those valiant mindes that doe attempt such desperate voyages, and the rather when they doe it for knowledge sake, and to profit their countrie, and not altogether for priuate gaine and lucre

But truely for mine owne part, I thinke it vnpossible that any man bred in anye of the temperate zones or in the hotte zone is euer able to continue the whole iournie in any of those 3. waies: no, though they were much more passable then I take the to be indeed. But if they were passable in all respects, sauing for cold, then I thinke no nation or people so meet to attempt those waies as those which I haue alreadie named, or such like, borne and bred nigh vnto the north seas. But leauing these matters, let vs now shew how euery one of the 4 foresaid partes of the Earth, that is, Europe, Afrike, Asia, & America, is bounded, & how many miles each part containeth aswell in longitude as in latitude, according to such longitude, & latitude as Mercator & Puteanus doe set downe in their Maps.

Europe is bounded on the North with the North Ocean Sea, and on the South with the Sea called Mare Mediterraneum, on the East with the floud Tanais, and on the West with the west Ocean Sea. Europe in measuring with a right line from the furthest part of Ireland on the West vnto the floud Tanais, on the East both places hauing 52. degrees of latitude, hath in longitude 2166 miles, and in measuring with a right line from the furthest part of Morea on the South, whose latitude is 35 degrees vnto the North Sea side hauing 72 degrees of latitude, hath in latitude 2220 miles. Afrik is bounded on the north with the straight sea Gibalter & with the sea called Mare Mediterraneum & on ỹ south with a sea which deuideth Afrike frō the south land not yet fullie knowne, & on the East with the red sea or gulfe of Arabia, and on the west with the great Ocean Atlantique. Afrike in measuring with a right line from Gambra on the west vnto the Cape de Gardasa on the East, both places hauing 10 degrees of North latitude, or there about, hath in longitude 4425 miles. And measuring with a right line from the 50. degree of the Equinoctiall vnto the Sea called Mare mediterraneum, it hath in

North Latitude 32. degrées, which being multiplyed by 60. maketh 1920. miles. In South Latitude measuring with a right line, from the 50. degrée of the Equinoctial vnto the Cape of good hope, called in Italian Capo di buona speranza, and in Latine Capud bonæ spei, it hath 35: degrées, which being multiplyed by 60. maketh 2100. miles, which maketh the whole Latitude of Africa to be 4020. miles.

Asia. Asia is bounded on the North, with the North Ocean sea, and, on the South partly with the red sea, which Sea according to Pomponius Mela, extendeth to the Isle somtime called Taprobana now Sumatra: which is a famous market place of all manner of spices. Also Asia is bounded on the South with diuers other gulphes and seas, as you may see in the Map: Againe on the East it is bounded with the East Indian Ocean, and with the straight sea of Anian, and on the West, it hath the floud Tanais & the Fenne of Meotis, and diuers seas, as Bosphorus Cimmerius the sea called Mare Euxinum, the sea Bosphorus Thracius and Propontis, and part of the sea Mediterraneum, and part of the red sea or gulfe of Arabia, which diuideth Affrike from Arabia Felix. Asia in measuring with a right line from the mouth of the floud Tanais to the promontorie Tamos, both places hauing 50. degrées of Latitude, hath in Longitude 4284. miles, and in measuring with a right line from the 150. degrée of the Equinoctiall vnto the promontorie Tabin, Asia hath in North Latitude 75. degrées, which being multiplied by 60. maketh 4500. miles.

America. America is bounded on the North, with the North Ocean sea and on the South, with the sea called Mare Magellanicum, on the East with the great Ocean Atlantique, and on the west with the West Indian Ocean, and the strait Sea of Anian America in measuring with a right line from the straite of Anian to the furthest part of Estotilant vpon the 64. degrée of Latitude, hath in Longitude 164. degrées which maketh 4264. miles, and in measuring with a right line from the 270. degrée of the Equinoctiall vnto the North sea, it hath in North Latitude 76. degrées, which maketh 4560. miles, and yet the quantitie of the ground described in the Map, is not so great as the other by a seauenth parte: wherein I can very well excuse the Mappe-makers, not hauing

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perhaps as yet the true Longitude of that part of America.

Finally, in measuring with a right line from the 305. degrée of the Equinoctiall vnto the sea called Mare Magellanicum, it hath in South Latitude 53. degrées 30. which maketh 3210. miles.

Now if you would know what kingdomes, Regions, Cities, Mountaines, Fluds, Lakes, also what seas together with their Ilands, Ports, Capes, Points, and baies doe belong to euery one of the foresaid foure parts, then studie well these moderne Maps: and with your eye you shall beholde, not onely the whole world at one view, but also euery particular place contained therin. Which to describe at the ful, in writing would require a long time, wherfore leauing that to your owne industrie, I will shew you how to find out the Longitude and Latitude of any place in the Mappe.

How to find out the Longitude and Latitude of any place contained in the Mappe.

Also to know how one place lieth from another, and with what wind you haue to saile from one place to another. And finally how to find out the true distance betwixt place and place, in which things the chiefe vse of Maps doth consist.

And first you haue to vnderstande, that the Meridians which you sée in the Map, doe serue for diuers purposes. For you learne thereby that it is noone-tyde or midday sooner to one place then to another, by marking what Meridian is more towards the East, which the Sun alwaies toucheth sooner then that Meridian which is more towards the west. Also by the Meridians you know how the Eclipse of the Moone appeareth sooner to one place then to an other, and with what varietie of time.

For they whose Meridian is towards the West, doe sée the Eclipse of the Moone sooner then they whose Meridian is more towards the East, wheras in very truth the Eclipse of the moon is séene to all places (where it can be séene) at one very instant of like greatnesse, and yet séemeth to be séene later or sooner, by reason of the diuersitie of the time of the day, in places standing one East or West from another. And if the distance betwixt those two Meridians doe containe 15. degrées of the Equinoctiall, then the Eclips appeareth to bee sooner to the one then to the other by one whole hower. For euery 15. degrées maketh an hower, and therefore looke how many 15. degrées you find betwixt the two Meridians

dians, so many howers are to be accounted. And if you find fewer degrées then the time of the Eclips is to be shortned accordingly, and by attributing 4. minutes of an howre to one degree, (for foure times 15. maketh 60. minutes, which is also one houre) you may make your account so small or great as you will. And note also that you may conceiue to be in the map as many Meridians as there are degrees in the Equinoctiall.

As for the Eclipse of the Sunne, it is seene neither generally, nor fully at one selfe same time, nor yet of the same greatnes in all places, Indeed it appeareth sooner to the Westerne Countries, then to the Easterne. But the diuersity of the time of appearance doth depend not onely of the number of Meridians, betwixt the two places, but also of the swift or slow motion of the Moone, which comming betwixt vs and the Sunne, taketh the sight of the Sun from vs.

Moreouer by the Meridians you shall know what longitude any place in the Map hath, by doing thus. First set the one foot of your compasse in the place it selfe, and the other in some Meridian that is next vnto it, whether it bee on the left or right hand, it maketh no matter: and from thence draw downe your compasse following still that Meridian vntill you come to the Equinoctiall line, and there marke vpon what degree of the Equinoctiall that foot of your compasse which you did first put in the place, doth rest and there make a pricke. That done, count how many degrées that is distant from the first Meridian, and that is the true longitude of the place: and that longitude serueth to al the places that be vnder that Meridian, though they be neuer so far distant one from another North and South.

Now if you would knowe the latitude of any place in the Map that is to say, how farre it is distant from the Equinoctiall, either Northward or southward, either of which latitudes containeth 90. degrées, then do thus: set the one foot of your compasse vpon the very place, and the other vpon that paralell which is next it, whether the paralell bee aboue it or beneath, it maketh no matter, and draw your compasse from that place, following still that Paralell vntill you come to that Meridian which is marked with the degrees of Latitude, which Meridian in the latter Mappes,

standeth

standeth somwhat more west then the first Meridian doth. And marke vpon what degrée that foote of your Compasse which you did draw from the place doth rest, and there make a pricke. That done, count how manie degrées that pricke is distant from the Equinoctiall, and that is the true latitude of that place. And the like latitude haue all they that dwell vnder that Paralell, howe farre so euer they dwell asunder, East and West. And by knowing the latitude of any place, you may quicklie finde also in some Mappes vnder what clime or Paralell such place is situated, and of how manie houres the longest day is there, as in the Mappe of Vopellius, of Gemma Frizius and diuers others. But in these latter Mappes such thinges are not set forth, wherefore not hauing the other Mappes, you may resort to the Tables set downe in my sphere, which doe shew all such thinges at the full.

How to know how one place beareth from another, and with what wind a ship is to be directed from one port vnto another, & also what distance is betwixt 2 places, that is, howe many miles one place is distant from another, the latter Cosmographers, as Mercator, Barnardus, Puteanus, and diuers others haue inuented a new instrument called Organum directorium, which they set downe in their Mappes together with the vse thereof. But in mine opinion not plainely enough for most mens capacitie. This Instrument containeth 2 Quadrants of a Circle, hauing the names of the windes written therein: And they call the vpper Quadrant Organum Superius, and the nether Quadrant Organum Inferius. Which two Quadrants haue two lines marked with degrées, and are ioyned together with a right angle, of which two lines the standing or hanging line on the left hand doth signifie the first Meridian, and is marked with 75. vnequall degrées of latitude, in such proportion as the middle Meridian of the Map hath. The other line which lieth ouerthwart, signifieth the Equinoctial, and is marked with 90. equall degrées of longitude. But the spaces of the Paralels of latitude are in number 7. and a halfe, euery whole space containing 10 degrées, and the halfe space but fiue degrées. Which spaces are wider and wider towardes the Pole, and of like proportion to those of the Mappe.

Organum directorium with the description & vse thereof.

Any

And note by the way that the highest right line that goeth from the first Meridian towards your right hand, is the East line, and the nethermost line signifying the Equinoctiall is the West line. For the vpper Quadrant commeth towardes you from East to South, and the nether Quadrant goeth from you towardes the left hand from West to South, and in the Center of each Quadrant must bee put a long thread to shew the direction from place to place. The vse of this Instrument is thus: first hauing found out in the Mappe the seuerall Longitudes, and Latitudes of two places in such order as is before taught, seeke the Latitude of the first place in the first Meridian, and there make a marke. I call here the first place, that from whence you goe, and the second that to which you goe. That done, seeke out in the saide Meridian the Latitude of the second place, and there make another marke. And from that marke of the second place drawe a right line towardes your right hand; so as it may bee a Paralel to the Equinoctiall line. Then take the difference of the two Longitudes by subtracting the lesser out of the greater, and seeke out the degrees of that difference in the Equinoctial line, and there make a marke, from which marke draw a right line that may bee a Paralel to the first Meridian. And whereas this line crosseth the first line, there set downe a marke, then draw a right line from the marke of the first place, so as it may passe through the crossing point. That done, if the Latitude of the first place be greater then that of the second place, make a Paralel to that line with the threade of the vpper Quadrant, but if the Latitude of the first be lesser then the second, then make a Paralel vnto the saide line with the thread of the nether Quadrant, which with the helpe of your Compasse you shall easily doe. And that threade being stretched out amongest the winds, will shew by what wind the second place beareth from the first. And the opposite wind is the director whereby you haue to saile: yet neither Mercator nor Barnardus doe plainely shew how to find out the true distance of two places by this instrument, nor yet doe set downe in their Mappes, either skale or tronke to take the distance betwixt two places with the Compasse, as most commonly all other Maps and Mariners Cardes haue, but doe referre the plaine declaration thereof to other their bookes & Ta-

bles

bles which I haue not yet seene, and therefore in the meane time I thought good to set downe according to Barnardes rule, this briefe way of finding out the distance of any two places whatsoeuer is set downe in their Maps. First with your Compasse, take the iust distance of the two Latitudes vpon the first Meridian which is otherwise called the difference of the Latitude. And hauing layd a ruler or thread to the places, looke howe many times the foresaid distance, or difference taken with your Compasse, is comprehended in the space that lyeth betwixt the two places, and by so many times multiply the said difference, the product whereof being multiplyed againe by 60. will shewe how many miles the one place is distant from the other. As for example, the distance or difference betwixt the two Latitudes of London and Hierusalem, is 19. degrees or there abouts, which being taken with your compasse you find to be two times contained in the space betwixt Hierusalem and London. Wherefore in multiplying 19. degr. by 2. you find the product to bee 38. which being multiplyed by 60. maketh 2280. miles, and so farre is Hierusalem from London by a right line. But if in measuring the distance betwixt two places with your Compasse there remaine any od space not fully answering the first wideneſſe of your Compasse, then take that odde space with your Compasse being straightned and made fit thereunto, and looke how many degrees the said odde space comprehendeth in the first Meridian, about the midst of the degrees of the foresaid difference of Latitude, and adde those degrees also to the rest which you haue already measured and multiplyed, and by multiplying the whole summe by 60. you shall haue the true distance.

Againe, it may bee that the two places doe not differ at all in Latitude but only in longitude, for as I haue saide in my Sphere, two places may differ three maner of wayes: that is in Latitude onely, in Longitude onely, or in both. And there I doe shew howe euery one is to be measured.

But because that order of measuring is some what harde to such as are not very well exercised in Arethmeticke, and doe not knowe the vse of the tables of Sines called in Latine Tabulæ Sinuum, I thought good to set downe here a more easie way of measuring,

suring, though perhaps not altogether so iustlie, and yet without any great errour. Wherefore if the two places doe differ both in longitude & latitude, then you must doe as before is taught. But if they differ onely in latitude, then you haue no more to doe but to multiplie the difference of the two latitudes by 60. miles, and if there bee any odde minutes, then to allow for euery minute one mile. As for example Compostella and Lisbone, two Townes, the one in Spaine, and the other in Portugale haue one selfe same longitude differing only in latitude, which difference is 4 degrees, and 20 minutes.

Here if you multiply foure by 60 it amounteth to 240 miles, whereunto by adding 20 miles for the twentie minutes, you shall finde the whole summe to be 260 miles, which is the distance by a right line betwixt Compostella and Lisbona.

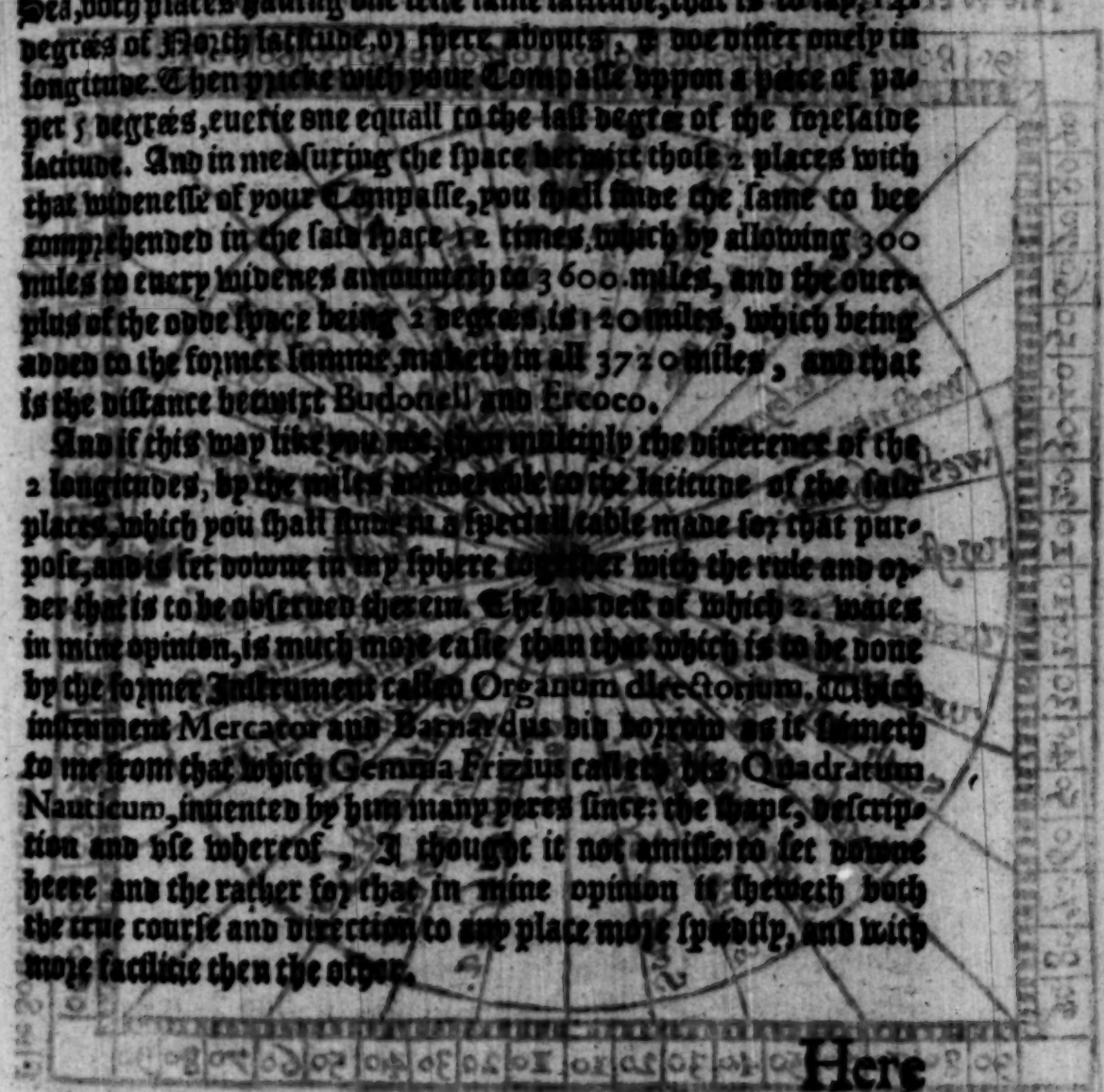
But if the two places hauing one selfe latitude, doe differ onlie in longitude, then looke how many such degrees as are of equall quantitie to the last degree of the same latitude are contained betwixt the two places by a right line, and by allowing for euerie degree 60 miles, you shall haue the true distance, or at the least not much differing from the truth. And if you see that the two places in the mappe doe stand far a sunder, then for the more speedines, take with your compasse fiue such degrees at once, being first pricked vpon a peece of paper which is iust 300. miles, and at that wideneese measure the said space, and if there remaine at the least any odd space, then straighten your Compasse and fit them to that odde space, and looke how many of the foresaid degrees that comprehendeth, and hauing multiplied the same by sixtie adde the product thereof to the former summe.

As for example, Compostella and Constantinople, hauing one selfe same latitude, that is, fortie three degrees of North latitude doe differ onelie in longitude: Heere with my Compasse I pricke vppon a peece of paper fiue degrees like in quantitie to the last and vppermost degree of the foresaid fortie three degrees, and measuring with the wideneese of my Compasse the space betwixt the two places by a ruler or right line I finde that space to comprehend the foresaid wideneese of my compasse 6 times, which maketh 1800 miles, & that there remaineth

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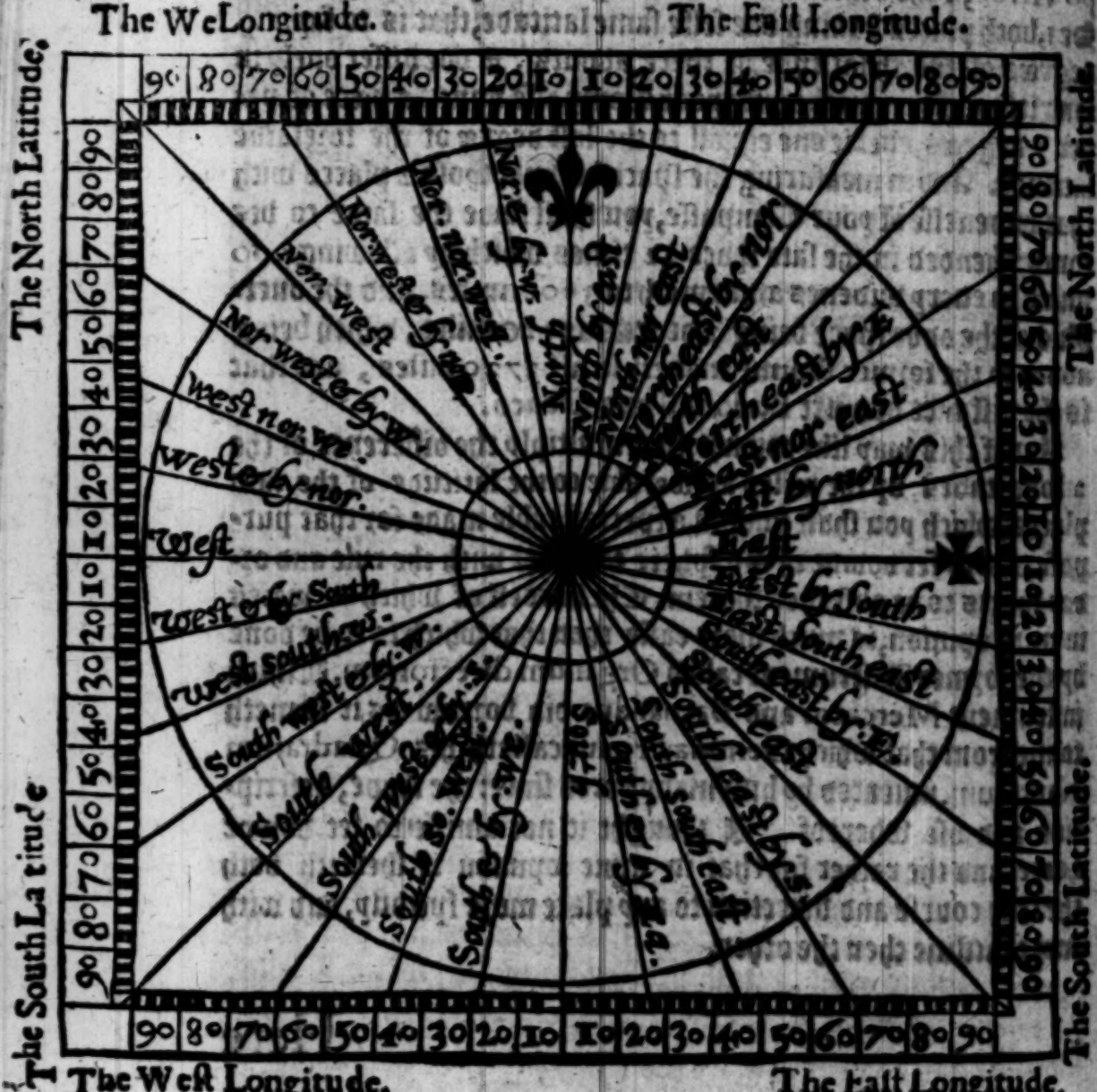
an odde ſpace containing 3 of the foreſaid degrees, that is, 180. miles, which being added to the former ſumme, maketh in all 1980. miles, which is the diſtance betwixt Compoſtella and Conſtantinople. Alſo if you would knowe the diſtance betwixt two Townes in Africke, the one called Budonell ſtanding vpon Capo viride, & the other called Ercoco, ſtanding hard by the red Sea, both places hauing one ſelfe ſame latitude, that is to ſay, 14. degrees of North latitude, or there abouts, & doe differ onely in longitude. Then pricke with your Compaſſe vppon a peece of paper 5 degrees, euerie one equall to the laſt degree of the foreſaide latitude. And in meaſuring the ſpace betwixt thoſe 2 places with that wideneſſe of your Compaſſe, you ſhall finde the ſame to be comprehended in the ſaid ſpace 12 times, which by allowing 300 miles to euery wideneſs amounteth to 3600. miles, and the ouerplus of the odde ſpace being 2 degrees, is 120 miles, which being added to the former ſumme, maketh in all 3720 miles, and that is the diſtance betwixt Budonell and Ercoco.

And if this way like you not, then multiply the difference of the 2 longitudes, by the miles anſwerable to the latitude of the ſaide places, which you ſhall finde in a ſpeciall table made for that purpoſe, and is ſet downe in my ſphere together with the rule and order that is to be obſerued therein. The hardeſt of which 2. waies in mine opinion, is much more eaſie than that which is to be done by the former Inſtrument called Organum directorium, which inſtrument Mercator and Barnardus did borrow as it ſeemeth to me from that which Gemma Frizius calleth his Quadratum Nauticum, inuented by him many yeres ſince: the ſhape, deſcription and vſe whereof, I thought it not amiſſe to ſet downe heere and the rather for that in mine opinion it ſheweth both the true courſe and direction to any place more ſpeedily, and with more facilitie then the other.



Here

Here followeth the Mariners Quadrant.



A DESCRIPTION OF Gemma Frizius his instrument called Quadratum Nauticum.

THis square by two right lines called Diameters crossing one another with right angles in the very Center is diuided into foure equall quarters, and within the said square vpon the said Center is drawne a Circle, which by meanes of the two foresaide Diameters is also deuided into 4 Quadrants, and euery Quadrant is subdiuided with right lines into 8 partes, so as in all, there bee 32. lines, signifying the 32 windes of the Mariners Compasse. Euery line having his proper name of wind written thereon. And note that the right line which is drawne right downe in the midst of the square, signifieth the Meridian, shewing the North point aboue, and the South point beneath, and the other right line, crossing the same in the center, signifieth the Equinoctiall line, which sheweth the East point on the right hande, and the West point on the left hand, and the Circle it selfe signifieth the Horizon.

Now you haue to vnderstand, that from the Equinoctiall line vpwardes the 2 sides of the square are diuided each of them into 90 degrees of North latitude, and the other two sides from the Equinoctiall downeward, are likewise deuided on both hands into 90 degrees of South latitude. Then the head or front, & also the base of the said square is deuided in the middest by the foresaid Meridian line into 2 equall partes, whereof the first proceeding

from

from the saide Meridian towardes the right hand is deuided as well aboue as beneath into 90. degrees of longitude, and that is called the East longitude, and the other part proceeding from the said Meridian towards the left hand is likewise deuided as well aboue as beneath into 90. degrees of longitude, and is called the West longitude. The vse of which instrument is thus: First knowing by some Table or Map, the longitude and latitude of two places, take the difference of both by subtracting the lesser out of the greater. And if the longitude of the second place be greater then the first, seeke the difference thereof in the front, and also in the base of the East longitude on the right hand. But if the Longitude of the second place bee lesse then the first, then seeke the difference thereof in the West longitude on the left hande. And heere as before I meane by the first place that from whence you goe, of which two places, the first is alwaies supposed to be in the very center of the circle, and the other is to be found out thus: first, hauing sought out the degrees of the difference of the longitude, as well in the vpper part, as in the nether part, and marked the same with one pricke aboue, and another beneath, applie your Ruler or a thred to those 2 prickes, or els draw a secret right line from the one pricke to the other by a ruler. That done, seeke out the difference of the two latitudes on both sides of the square, that is to say, if the second place hath greater latitude then the first, then you must seeke the difference in the North latitude, if lesse, then seeke that in the South latitude. And hauing marked the same on both hands, by setting downe on each side a pricke, draw a secret right line from marke to marke, and where the last line crosseth the first line, there make a marke, for there standeth the place whereto you would goe. Which if you would know how it beareth from the first place, then lay your ruler both to the Center and also to that marke, drawing a right line passing through the Center, and also through the said marke from the one side of the Circle to the other, or els stretch a thread through the Center & the marke, and on that side that the marke is, you shall see the name of the winde that sheweth how the second place beareth from you, the opposite point whereof is the winde whereby you haue to saile. As for example, if you would know how

The North Latitude.

how Venice beareth from London.

Now if you seeke in the Map, you shal finde London to haue in longitude 23. degrées and 0 minutes and in latitude 51. degrées and 32. minutes. Againe you shall finde Venice to haue in longitude 36. degrées, and 30 minutes, and in latitude 45. degrées & 15 minutes or there abouts.

The difference of the longitude is 13. degrees and 30. minutes, which because the longitude of Venice is greater then the longitude of London, you must seeke it out in the East longitude on the right hand, and marke the same both aboue and beneath. Againe the difference of latitude is 6. degrées and 17. minutes. Which because Venice hath the lesser latitude, seeke that out in the South latitude, marking the same on both hands. That doone lay two threades, or els draw two right crosse lines from the foresaid markes, and where those two threades or lines do crosse, make a marke, which marke signifieth the place whereunto you would goe which is Venice.

Then from the one side of the Circle to the other, lay a ruler, or thread passing through the Center, and the said marke made for Venice, at the end of which thread, ruler, or line on the right hand you shall see the wind which sheweth how Venice beareth from London, and on the left hand the wind whereby you haue to saile if the space betwixt the two places were all sea. For in sayling by sea, you may not thinke to goe alwaies by a right line, but often to change your course according as either mainland, heblands, Iles Currents, Sands, Rockes, or such like impediments shall giue occasion: and therefore thuogh your right course from London to Venice is to goe Southwest and by East, yet being come out of the Thames to Douer, your course from thence to the Cape of Britaine is West Southwest. And from thence to the Cape Finis terræ in Spaine, it is Southwest & by South. And from thence to the cape saint Vincent in Portugall you goe right South: & from thence to Gibralter almost East Southeast. Againe from Gibralter to the South point of Sardignia, your course is almost East and by North. And from thence to the south point of Sicilia almost East Southeast: and from thence to Corfu, your course is iust Northeast, and from thence to Venice, you

turne againe Northwest.

Thus you sée that in going by Sea, one course doth not hold, no nor yet in going by land, sith Mountaines, Riuers, and Lakes, may put you out of your right course, & yet it is necessary to know how the place whereunto you goe, beareth from you, to the intent that being out of your way, you may alwaies the better direct your course right againe to the same.

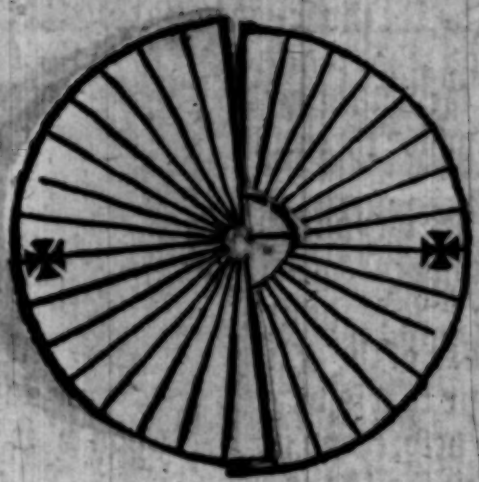
Moreouer, Gemma Frizius saith, that by this Instrument you may also finde out the difference of longitude betwixt the two places from whence and whether you goe, so as you know before how the second place beareth from the first, and also the difference of their latitudes. As for the latitude of each place, you may easilie finde the same with your Astrolabe Quadrant, or crosse staffe, by taking therewith the Meridian altitude of the sunne, or the highest altitude of some Starre that you know: The order whereof, I haue set downe in my Sphære. And the coast of the Countrie & place whereunto the Shippe is to be directed, is commonly well knowne to the Marriners how it beareth from the first, and specially hauing a prosperous wind.

Then knowing these two thinges, you must doe thus: First, hauing drawen a secret line or thread, from the difference of the two latitudes, placed according to the rule of greater and lesser, before set downe, and marked on both sides of the Instrument: draw another thread, or els lay a ruler so as it may passe through the Center, and the line of the winde, or coast whereby the second place beareth from the first. And whereas those two lines or threads doe touch, make a marke, and then lay a Ruler, or extend a thread from the vpper line to the neather line of longitude, so as it may passe hard by the last marke, and then the thread or Ruler so laid, will shew you the difference of longitude betwixt the two places. And by this meanes Gemma Frizius saith, that the Marriners may easilie correct the longitudes of place as they Saile: but how truely, I referre that to the skilfull Pilots.

But for mine owne part, hauing to seeke out in these latter mappes the way by Sea or Land to any place, I would vse none other Instrument of direction then halfe a Circle diuided with lines like a Mariners Flie, in such sort as you sée in this Figure.

THE

The shape of the Flie, the vse whee of followeth.



THis Flie containeth two quarters of the Mariners Compasse, the middle line whereof marked with a Crosse signifieth the line which runneth East and West. For if the place whereto you goe, bee on your right hande, then the Crosse signifieth the East point, but if it bee on your left hand, then turning the Flie towards your left hande, the Crosse doth signifie the West point, and the right downe line Crossing the foresaid middle line with right angles in the verie Center, is the Meridian line shewing the North and South, according as you turne the Crosse, East or West.

The vse of which Flie is thus: first with a pin or a needle being

thrust through the center of the Flie, pricke the pin downe in the verie place from whence you goe, called before the first place; and if the second place be on your right hand, then turne the Crosse of your Flie that way, but so as the Meridian of the Flie may bee a true Paralel to the next Meridian of the Mappe that is on your left hand, which your Compasse will quicklie performe by taking therewith a iust space at both endes of the Flie betwixt the two foresaide Meridians, that is to say, the Meridian of the Flie, and the next Meridian, of the Carde or Mappe.

That done extend your thred so as it may passe through both the Center of the Flie hard by the pinne, and also through the second place, & then looke vppon what wind or coast of the Flie the thread lieth, and that winde sheweth how the second place beareth from you. And the opposite winde thereof sheweth by what winde you haue to sayle thether.

But if the second place bee on your left hand, then you must turne the crosse of the Flie towardes your left hand, and hauing set downe the Center of the Flie in the first place, and with your Compasse made the Meridian of the Flie a iust Paralell to the next Meridian of the Mappe that is on your right hand, lay your thread to the two places as before, and marke vppon what winde of the Fly it striketh, and you shall haue your desire. The lesser that your Flie be, the better, for beeing great it would couer too many places of the Carde or Mappe. But if the two places stand so nigh together, as the Flie doth couer them both, then hauing set downe your pinne in the first place, make your thread with a nose, and hauing put the same ouer the pin, drawe the threade through the second place somewhat beyond the Compasse of the Flie, and hold it there fast vntill you haue also put the Center of the Flie ouer the said pinne or needle, and duely placed the same in such forme as it is before taught, and in so doing, that line of the Fly which lieth vpon the thread will shew your course and direction aswell as if the thread lay aboue the Flie.

Truely I doe thinke the vse of this Flie a more easie and speedy way of Direction, then the manifold tracing of the Mappes or Marriners Cardes, with such a number of crosse lines, as commonly are drawne therein, causing rather a confusion then otherwise:

wise: for in such Cardes as are made with right Meridians, you shall finde the Flie to be much more seruiceable then these manifold lines.

The vse of Ptolomies tables.



Thus much touching the vse of Mappes, and Cardes, now according to my promise, I will briefelie shew you the vse of Ptolomies Tables, or of any other table made in that forme. The chiefest point whereof is readily to finde out any place that you seeke, and to know where it standeth: For the accomplishment whereof, you must first know what longitude and latitude that place hath.

The longitudes, and latitudes of all places described by Ptolomie, are set downe in his second, third, fourth, fift, sixt, and seuenth booke of Geographie. For in his second booke he describeth the West part of Europe, containing Ireland, England, and Scotland, Hispania, Gallia, Germanie, Hungarie, and Slauony. In his third booke he describeth the East part of Europe, as Italie, Sicilia, Corsica, Sardignia, Sarmatia, Taurica, Peninsula, Datia, Misia, Thracia, Macedonia, Achaia, Peloponesus, Candia, Rubia, and diuers other Lands and Islands. And hee containeth all Europe in ten Tables. In his fourth booke he describeth Africke, that is to say, so much as was knowne in his time, containing the same foure Tables. In his fift, sixt, & seuenth booke, he describeth all Asia and the East Indians, whereof he maketh 12. tables, and in describing any Region or prouince, hee sheweth how it is bounded both North and South, East and West. And also what notable Cities, Flouds, Lakes or Mountaines be in euerie Region, and therewith setteth downe the longitude and latitude of euery place: to which his book, diuers haue made certaine Alphabeticall tables, containing the names of all the places that are mentioned in the foresaid books, shewing in what leafe to finde the same: to the intent that you may the more readily finde out, not onelie the place, but also the longitude and latitude thereof, and in what Table it is contained.

Notwithſtanding, I know by good triall, that there are a number of places mentioned in the ſaid bookes, which you ſhall not finde in the foreſaid Alphabet.

Wherefore I wiſh, that Mercator, Ortellius, Barnardus, Brugenſis, or any other of the Coſmographers and ſetters forth of Maps and Cardes, would take the paine to make a generall Alphabet, containing all the names that are to be found and knowen, both auncyent and moderne, of Regions, Citties, Seas, Floudes Lakes, Riuers, Portes, Bayes, Hedlandes Capes, Mountaines, and all other notorious places, contayned in their Maps and Cards, together with the true longitude and latitude annexed to euery place, and agreeable to their Maps, to the intent that euerie man delighted with the reading of Hiſtories, may in their Mappes both generall and ſpecial, eaſily find out any place that hee ſeeketh. Which worke in mine opinion would bee moſt thankefully receyued of al thoſe that delight in Geographie, to the great commendation and praiſe of the Authors thereof.

For though Ptolomy, Appian, Gemma Frizius, Gaſtaldus, Orontius, Munſterus, Ortellius, and others haue ſet downe certaine names, both auncient and moderne together with their longitudes and latitudes, yet they are but very few in compariſon of all the names that are wanting yea or of thoſe that are comprehended in their owne Cards and Maps, all which Maps I wold wiſh to agree in their longitudes and latitudes: for otherwiſe a man ſhall hardly finde the place which hee ſeeketh.

Wherefore I pray God with all my hart, that ſome good man that is a ſkilfull Coſmographer may ſhortlie trauel here in to the profit of all Students in Geographie.

But now to returne to my matter, which is to ſhew how to find out any place contained in Ptolomies tables, I ſay that you muſt firſt finde out the name of the place in the Alphabet, and that will direct you to the booke wherein it is ſet downe, together with the longitude and latitude thereof. And there alſo you ſhall find in what table it is contained.

Then hauing taken a note of the longitude & latitude, and alſo the number of the table wherein it is to be ſought, reſort to that table, bee it in Europe, Affrike or Aſia. In the front of euerie which

table,

table, & also in the base are set downe certaine numbers of longitudes, in such sort as the vttermost and nethermost bee like numbers, and doe directly answer one another. Againe, on both sides of the Table are set downe certaine numbers of latitude like in quantitie, and directly answering one another.

Then seeke out the longitude of the place which you woulde finde in the front, and also in the base, and marke the same with two pricks, one aboue and another beneath: From which two pricks, lay a ruler or extend a thread, holding it fast there vntill you haue found out the latitude of the place on both sides of the table, which beeing also marked on each side with a pricke, extend another thread from those two last pricks, and in that verie point whereas the two threads doe crosse, you shall finde the place to be which you seeke, or at least should be there. Moreouer, on the right hand of euery Table, Ptolomie setteth downe most commonlie vnder what Clime and Paralel euerie place is, & by that meanes you may also know the longest day that any Paralel hath. For as I haue said before in my sphere, euery Paralel proceeding from the Equinoctiall towards the Pole, encreaseth by one quarter of an houre, and euery Clime containing two Paralels, encreaseth by halfe an houre.

Of which Climes Ptolomie setteth downe but seauen, but of Paralels hee maketh 21. in such order as this table following sheweth, which Table consisteth of foure Columns, whereof the first containeth the seauen Climes together with their names, & also how many miles euery Clime hath in breadth. And the second containeth 63 degrees of latitude, further then which Northward, Ptolomie his Tables doe not extend.

The third containeth the numbers of the 21 Paralels, and the fourth the houres and minutes of the longest day in euerie Paralel, as this table here next following sheweth.

	The seauen Climes with their names and miles in breadth, which you must count from beneath vpward.	The degrees of Paralels Latitude.			The houres and minutes of the longest day in euery paralell. H M
		63		21	19 30
				20	19 0
		60		19	18 30
				18	18 0
				17	17 30
7	Dia Riphios. 195.			16	17 0
		50		15	16 30
6	Dia Boristines. 225.			14	16 0
				13	15 30
	Dia Romes.			12	15 0
5	270.	40		11	14 45
	Dia Rhodou.			10	14 30
4	350.			9	14 15
				8	14 0
	Dia Alexandrias.	30			13 45
3	370.			7	13 30
				6	13 15
	Dia Sienes.			5	13 0
2	420.			4	13
		20			12 45
	Dia Meroes.			3	
1	465.				12 30
	765.			2	
		10			
				1	12 15

This nether line deuided into degrees, signifieth the Equinoctiall line, vnder which those that dwell haue no Latitude, and therefore they haue alwayes twelue howers daie, and twelue howers night.

But you haue to vnderstand, that whereas Ptolomey maketh the furthest North part of his seuenth Clime called Dia Riphæos to haue but 50 degrees and 30 minutes of latitude, the moderne Cosmographers do allow to those mountaines 70 degrées of latitude, affirming the same to be those selfe mountaines which are otherwise called Montes Hiperborei, which because they enclose a great part of the North side of the world, are called Orbis terræ cingulum, that is to say, the girdle of the worlde, the wrong latitude wherof and of diuers other, I thinke Ptolomey had from other and not from himselfe.

For beeing brought vp in so warme a soyle as Alexandria standeth in, he could neuer endure to goe so farre Northward, to take the latitude of those cold Riphean Mountaines, and therefore if you list to know what latitude doth truely belong vnto euerie Clime and Paralell, then resort to Orontius his Table of Climes and Paralels, set downe in my Sphere, which sheweth how many degrées of latitude euery Paralel hath, together with the longest day, euen from the Equinoctiall to the verie Pole, wherfore I leaue to speake here any further thereof, and so for this time end this Treatize.

Nowe here followeth the order of making Ptolomie his Tables and of all other Maps, both vniuersall and particular.

THE TRVE ORDER of making of Ptolomie his tables, and also the making of all *other tables Maps, or Cardes, as well* vniuersall as particular, and that according to the doctrine of the best Geographers, that be or haue beene in these latter dayes.

PLAINELY SET FORTH IN OVR NAtiue speech, by Master Blundeuile in the yeare of our Lord. 1597.



AT LONDON
Printed by *John Windet.*

THE

TRUE ORDER

of making of Ptolo-

mie his tables, and the making of all

Mineral Aspects, and that according to the

doctrine of the Ephemerides, that be for hare

hand these many dayes.

PLAINELY SET FORTH IN OVR NA-

tive speech, by Nathaniel Bladeuile in the

yeare of our Lord. 1597.

AT LONDON

Printed by Iohn Windet.

How to describe in manner of a Table,

like vnto the tables of Ptolomie any Countrie or Region, and all the places contained therein by knowing their longitudes and latitudes.

A For example you woulde describe the Countrie of Fraunce, which containeth in latitude 10. degrées, and in longitude 16. Here first you must drawe a perpendicular line through the midst of your Table or Carde from head to foot, signifying the Meridian or Axletree of the worlde, marked with the letters E F. as you may see in the former Table of Fraunce, and diuide that line into ten equall partes, then drawe two Paralell lines: whereof the one must crosse the said line aboue in the point e. with right angles, and the other Paralell must crosse it againe beneath in the point f. with like angles, & marke the vppermost Paralell with A. B. and the neathermost Paralell with C.D. Then with your Compasse take one of the 10 partes of the saide line e, f. which is one degree, and set that downe by it selfe, deuiding the same into 60 minutes as the short line G.H. set downe on the right hand of the former Table of France doth shew: And hauing learned by some Table or Mappe, that the furthest part of France northward, through which the Paralell A B, passeth is distante from the Equinoctiall 52 degrées, and that the South Paralell C. D. is distant from the Equinoctiall 42, degrees, & also hauing learned by another table, called the Table of miles here following, that to euery degree of the Paralell 42 mar-

marked with A B. doe belong 37. miles, & that to euery degrée of the Paralell marked in C D belongeth almost 45. miles. Take therefore with your Compasse from the short line. G H. 37. parts or minutes, and kéeping your Compasse at that wideness, diuide the paralel A B. into 16. equall spaces, answerable to that wideneſſe (that is to say) 8. partes on each side of the Meridian E F. at which Meridian you must begin to measure towardes eyther hand, both right and left, setting downe a pricke at the end of euerie such space. Then for the South Paralell C D. take from the short line G H. 45. partes or minutes, and diuide that Paralell into 16. spaces answerable to that wideneſſe of the Compasse, setting downe eight such spaces on each side of the Meridian E F. beginning to measure from the Meridian E F. as before, and set downe at the end of euery such space a pricke, then from those prickes, so set downe in each of the two Paralels. A B. and C D. drawe right lines from pricke to pricke, and those shall bée Meridians, shewing as well the longitude of the whole Region, as of euerie particular place contained therein.

Then like as the Meridian E F. is diuided into 10 equalparts: so diuide againe into the like partes each of the two outermost Meridians, as well that on the left hande, as that on the right hand, setting downe a pricke at the end of euerie such space, and from pricke to pricke drawe right lines passing through all the Meridians, and those shall be the Paralels, and in the outermost spaces write the numbers as wel of longitude as of latitude, beginning your longitude at the outermost Meridian on the left hand, which is the furthest Meridian Westward as well aboue as beneath.

And because that the furthest Meridian Westwarde is fourteéne degrées distant from the Meridian of Iusulæ fortunatæ, which of all the ancient Geographers is counted the first Meridian, remember therefore to set downe in the first space on the left hand aswell aboue as beneath, with Arithmeticall figures. 15. and in the second space 16. and in the third space 17. and so proceed from space to space till you come at 30. for betwixt 14. and 30. are contained 16. degrées, so haue you the whole longitude of Fraunce which is 16. degrées.

Thus

Thus hauing set downe the numbers of the degrées of latitude, beginning at each end of the South Paralell C D. and so procéde vpwarde alongst the two outermost Meridians, setting downe in the first space of the verie foote of the Table 43. degrées, as well on the one hand, as on the other, and in the second space 44. and in the third space 45. and so procéde vpwarde to 52. so haue you the whole latitude of France: for betwixt 42. and 52 are contained iust ten degrées, and if your Carde be large enough, you may diuide euery such space or degree as well of longitude, as of latitude into six partes, euery such part containing ten minutes.

Nowe to place Cities, or Castles, Riuers, Mountaines, or such like, you must learne the longitude and latitude of the same place, eyther by Ptolomies Tables, or by some more moderne Table or Mappe, and then set them downe in your Card or table accordingly. As for example, suppose that you would first set downe in the said Table the chiefe towne of Fraunce called Paris, whose longitude you finde by Iohnits Card, to be 23 degrées & o' the latitude thereof to bee 48. degrées. Here you must séeke out the said longitude by extending a thread from the 23. degrée of the Paralell A B. to the like degrée in the Paralell C D. and there holding it fast, crosse that thread with another thread extended from the Meridian A C. to the Meridian B D. in those two points, in which are set downe 48 degrées 1'o. and wheras the two threads doe crosse, there make a little round o. and write theron Paris, for that is his place, and as you haue set downe this Cittie, so you may set downe Orleans, Roane, Lyons, Tolous, as you see in the former table of Fraunce, and in like order you may set downe all other places and cities whatsoeuer.

But when you would describe any Riuer, then you must take the longitude and latitude as well of the beginning as of the ending thereof, and also the longitude and latitude of their boutes or and out, and to consider by what townes such Riuers doe passe, & on what side, and whether they passe through the middest of anie Towne or not, and what notable bridges are built ouer the same, and by like meanes you may place in your Carde, Woodes, Forrests, and Mountaines, and all other places whatsouer.

And

And you haue to note that all great Riuers doe commonly fall eyther into the sea, or els into some great lake, and the small Riuers doe fall into the great riuers.

Now to make a scale to your Carde, there is no more to doe but to know the distance betwixt any two places, eyther by relation, or by your owne experience, and then to draw three Paralell lines, making two spaces one larger and another lesser in some voide space of the Carde of such length as that voide space will giue you leaue, and to deuide the saide scale into so many maine miles as the length of the said void space will suffer you, and that according to the quantitie of the miles of distance first knowne. As for example, you know the distance betwixt Paris and Roane to be 30 French leagues, which is of our miles 60. allowing two miles to a French league: wherefore diuide your scale into 30 equall partes accordingly, and set downe numbers in the Larger space thus. 10, 20. 30. and so forth, so far as your void space will giue you leaue, and by taking with your Compasse the distance of any two places set downe in the Card, and applying the same to the scale, you shall know thereby how many miles such distance containeth, and to that end the narrow space would be deuided into 10 small and equall parts betokening single miles or leagues, as you see here in the scale set downe vnder the Table of France, and see that the knowne distance of the two places whereby you make your scale, may containe such number of leagues or miles as doe end in an article as in 10. 20. 30.

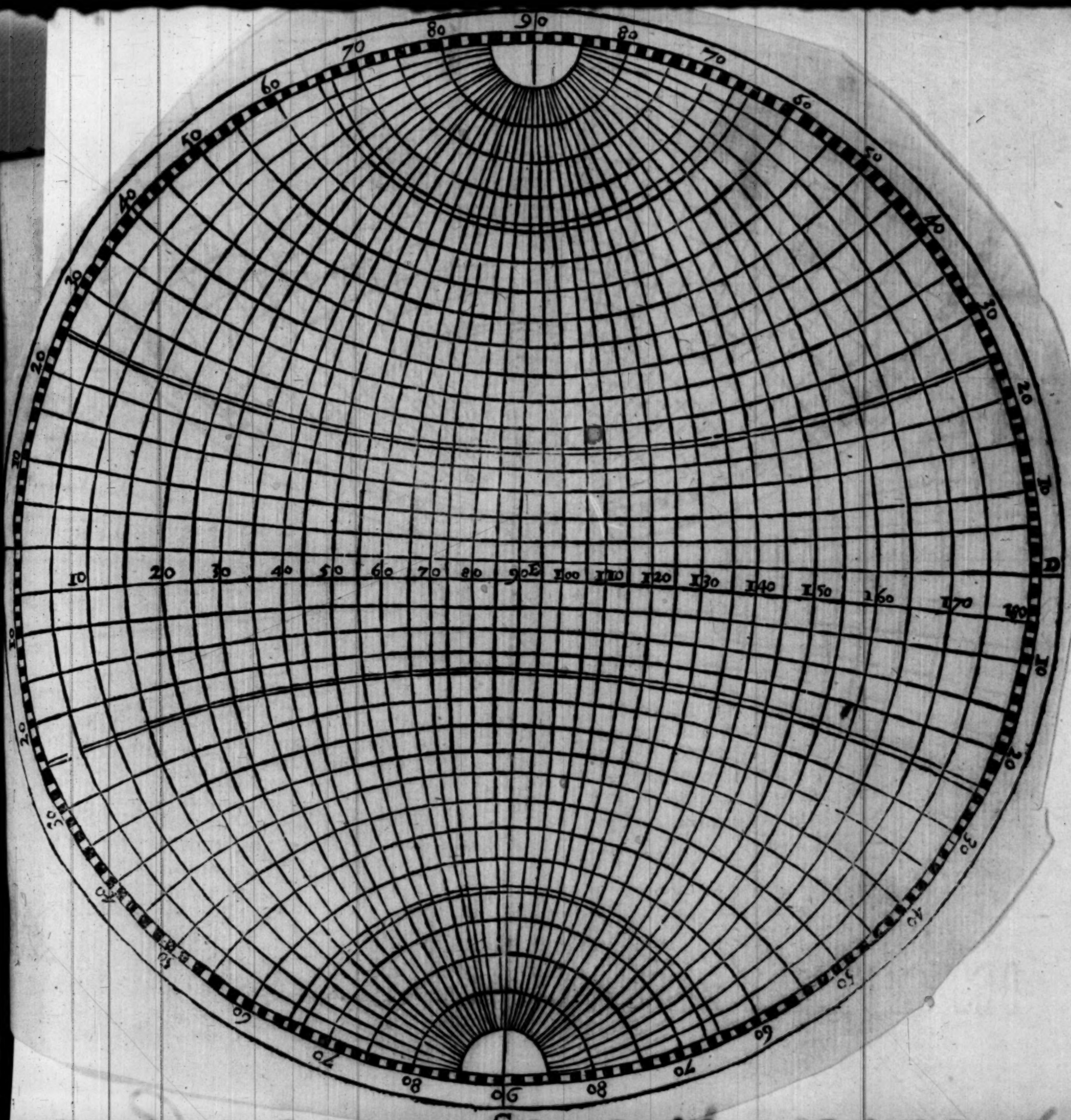
But one thing you haue to remember that though in making these kindes of Cardes or Tables, you bee willed to draw right lines from pricke to pricke, aswell to describe the Meridians as the Paralels, yet such lines would be drawne with blacke lead, so as they may be all wiped out, sauing whereas they crosse one another in the outermost spaces wherein you haue to set downe the degrees and minutes, as well of longitude as of latitude: for otherwise those right lines in small Cardes would somewhat hinder and disgrace your worke, neyther should it be like in al points, to those of Ptolomie and of all other moderne Writers describing any Countrie, in like maner in whose tables neyther the Meridians nor the Pararels are to be seene, but only in the outermost parts as is before said.

How

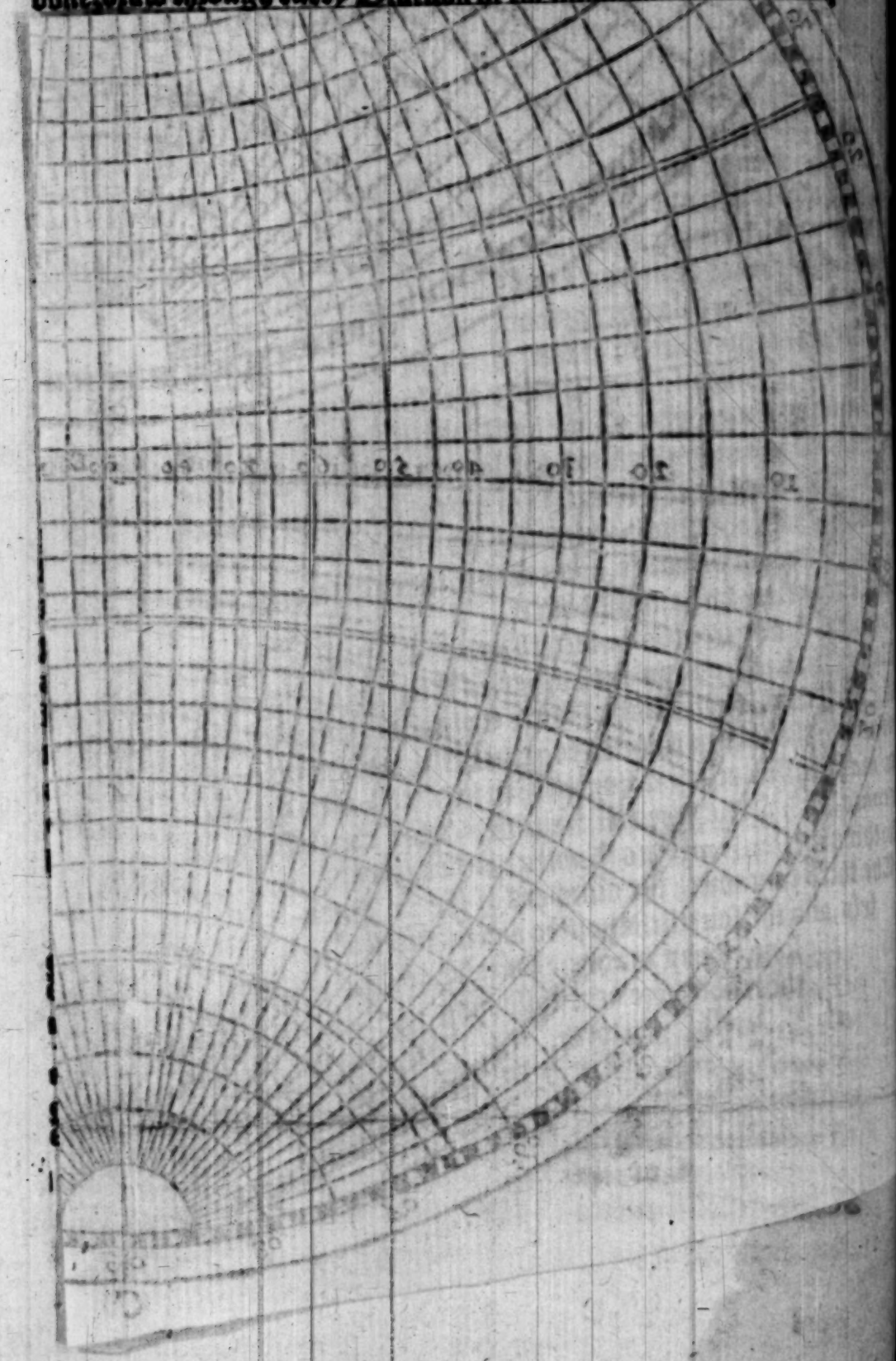
How to describe some particular region or part of the earth, in such sort as both the Meridians and the Paralels may be circular lines, and may bee like to the eight part of the conuex superficies of a Globe.

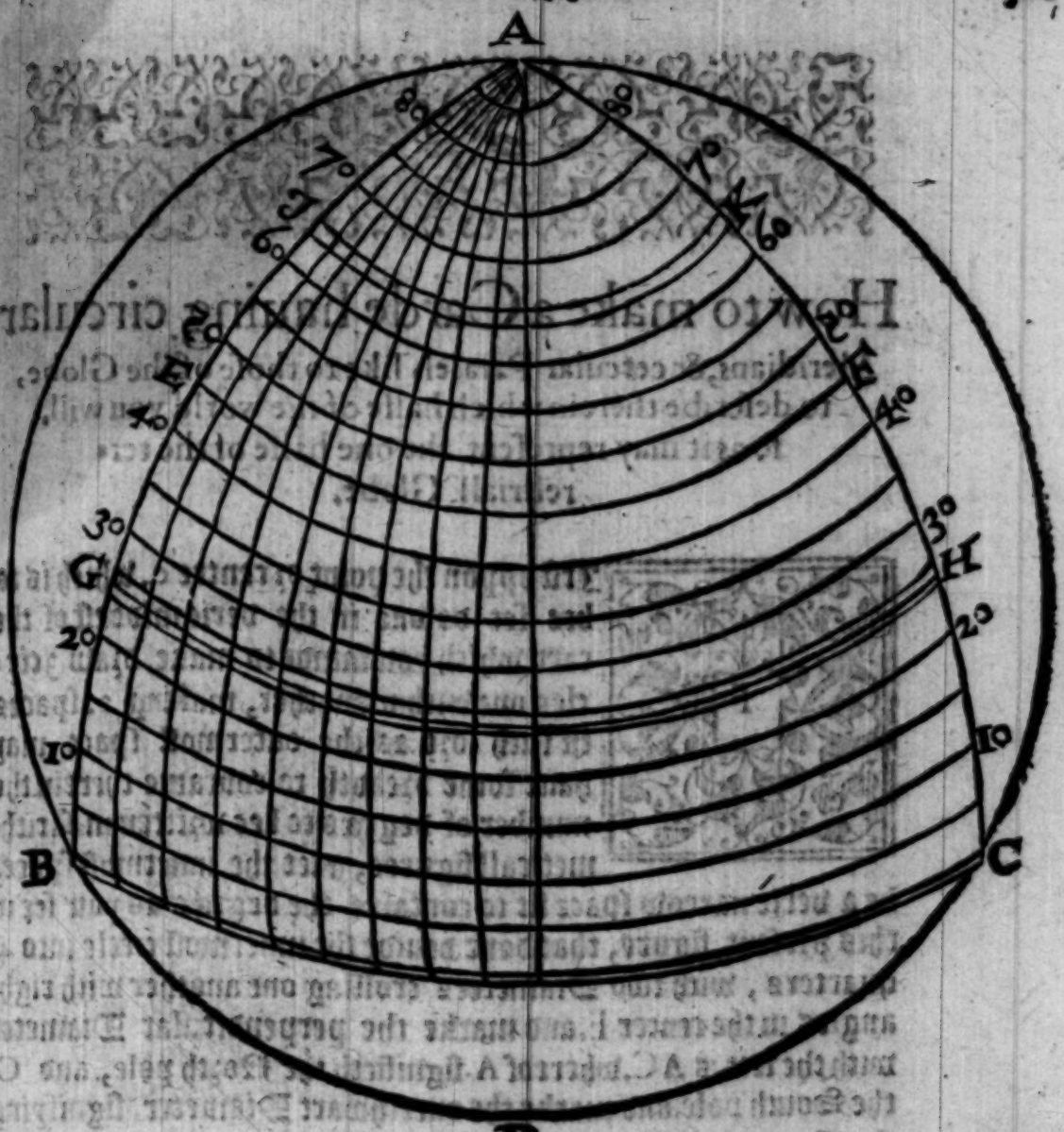
FIrst drawe a circle of some large quantitie, and diuide the same into three equall partes marked with the letters A.B.C. and let A be placed aboue, and B.C. beneath, as you see in the figure following. Then putting the firme foot of your Compasse in A extend the other foote to B. or C. and drawe an arch or portion of a circle, which may passe through B.C. and keeping your Compasse at that wideness; set the firme foote in C. and drawe the like arch from B. to A. and thirdly set the firme foote in D, and drawe the like arch from A. to C. and suppose A. to be the North pole, and the arch BC. to be a quadrant or fourth part of the Equinoctiall line, and suppose A.B. and AC. to be the sides of Meridians of other 2 quadrants: which 2 quadrants, together with the thirde quadrant BC. doe enclose the 8 part of the conuexe superficies of the Globe. That done, diuide the arch BC. into two equal parts, with the right line AD. which line AD. you must diuide into 9 equall partes, or into 18 parts, containing in all 90 degrees: so shall euerie space containe 5 degrees. That done set the firme foote of your Compasse in the point A, and drawe with the other foote so many Paralels as there are pointes of Diuision in the right line AD. making in all 18 Paralels, which Paralels must extend to the two out sides AB, and AC. Then diuide the quarter BC. in like manner into 18 equall parts, & also deuide the middle

Paralell marked with the letters E F. into 18 equall parts, that done, draw through euery Diuiſion of the quadrant B C, and alſo through the diuiſion of the paralell EF. Meridians anſwerable to the ſame, ſo as they may meet in the pole A. Of which Meridians AD. is a right line, and to doe that rightly you muſt finde out a ſeuerall Center for euery one of the ſaid Meridians, which is not eaſely done vnles you haue an Inſtrument meet for the turne, eſpecially if the Carde be of any greatneſſe, and hauing drawne your meridians, ſet numbers to euery one of the three quadrants, beginning to count the firſt 90 from B. to C. and ſecondly from B. to A. and thirdly from C. to A. that done, count in the Meridian AD. from d, vpward 23. degrees and 28 minutes which in theſe dayes is the greateſt declination of the Sunne, and there hauing made a pricke in the ſame line, put the firme foote of your Compaſſe in the pole A. and extend the other foote to the foreſaid pricke, through which you muſt draw a Paralell from the ſide AB, to the ſide AC. and marke the ſame with the letters GH. for that ſhall be the tropique of Cancer, then with your Compaſſe take the diſtance that is betwixt d, and the foreſaid tropique, and keeping your Compaſſe at that Wideneſs, ſet the firme foote thereof in A. and with the other foote draw another Paralell marked with the letters i, k, & that ſhall be the circle artique, whoſe diſtance from the Pole is alwaies equall to the greateſt declination of the ſun, and thus your Carde is readie to deſcribe therein any Region or Countrie, whereof the longitude doth not exceede 90. and that it hath North latitude, as this figure following plainelie ſheweth.


90
80
70
60
50
40
30
20
10
10
20
30
40
50
60
70
80
90E
100
110
120
130
140
150
160
170
180
D
70
20
30
40
50
60
70
80
90
80
70
60
50
40
30
20
10
20
30
40
50
60
70
80
90

Paralell marked with the letters E F, into 18 equall parts, that done, draw through euery Diuision of the quadrant B C




A
80
70
60
50
40
30
20
10
E
F
G
H
B
C
D

How to make a Carde hauing circular Meridians, & cercular Paralels like to those of the Globe, to describe therein which halfe of the world you will, so as it may represent the one halfe of the terrestriall Globe.

FIrst vppon the point or centre e, which is to bee set downe in the verie middest of the card which you minde to make, draw 3 circles one within another, making 2. spaces in such sort as the outermost space may haue some breadth to containe therein the number of degrées to bee written in Arithmeticall figures, & let the innermost space, be a verie narrow space fit to containe the degrées as you see in this present figure, that done deuide the innermost circle into 4. quarters, with two Diameters crossing one another with right angles in the center E. and marke the perpendicular Diameter with the lettes AC. whereof A. signifieth the North pole, and C. the South pole, and marke the ouerthwart Diameter, signifying the Equinoctiall with the letters BD. whereof B. is the West point, and d, the East point, then diuide euery quarter into 90. degrées beginning to account from B. to A. and also from d. to A. vpward, and from B to C, and likewise from d to C. downeward, then applie your ruler to the pole A. and to the fift degrée of the innermost circle proceeding from B. to C. and whereas your ruler crosseth the Equinoctiall, there make a pricke vppon the Equinoctiall, and so proceede towards c, from 5. degrées to 5. degrees, and againe from c, to d, in like manner not forgetting to

set

set downe prickes vpon the Equinoctiall at euery section, so shall you deuide the Equinoctial into 180 degrees, counting from b, to d, and therefore you must set downe vppon the Equinoctiall the numbers of the degrees thus, 10. 20. 30. and so forth, vntill you come to 180. as you see in the former figure. Then by laying the one end of your Ruler to b, and the other ende to euery fift degree of the semicircle a, d, c, deuide the Meridian a, c, as you did before deuide the Equinoctiall b, d, making prickes or strikes, vppon euery section or diuision of the same Meridian a, c, and these two lines (that is to say) the Equinoctiall line, and the Meridian line beeing thus deuided, you must draw vpon the two Poles a, e, Geographical Paralels, whereof you may draw two by setting the one foote of your compasse in the pole a, and the other foote in the first section of the Meridian a, c, that is next vnto a, and keeping your Compasse at that wideness, you may make the like Paralell vpon the South Pole by setting the one foot in the point c, and the other in that section of the said Meridian that is next vnto c, but to finde out the Centers of all the rest of the Paralels, both Northward and Southward, you must draw out the line ac. at both ends so long as you can, for in that line you haue to finde out all the Centers, which Centers must be such as the firme foot being set therein, the other foote may passe through euery section of the Meridian line, and also through euery fift degree of the inward circle containing the degrees on both sides of the said Meridian, and hauing drawne after this maner the 18. Northern Paralels, you may easily draw the other 18 Southern paralels by marking wel the first centers of the Northern paralels taking the iust distance of euerie one with your Compasses, and by setting downe the same vpon the Meridian line a, c, on the South part thereof.

Now to describe the Meridians, you must drawe out the line b, d, at both ends so farre in length as shall suffize, in which line you haue to finde out the Center of euery Meridian, first of those in the West part, and then of those in the East part, by setting the one foot of your Compasse in the Center, and the other foote so as it may passe through euery section of the line b, d, & also through both the poles, and hauing drawne the Westerly 18. Meridians,

you shall easily draw the Easterly Meridians by reducing the selfesame distances of Centers vnto the West part, by help whereof you did draw the Easterly Meridians, or els you may draw first a West Meridian, and then an East Meridian, whilest the Compasse is at one selfe wideness, and thereby you shall drawe 2 Meridians at one instant, and you may also obserue the like order in drawing the North & South paralels before mentioned. Then you haue to draw the two tropiques and the two polar circles in manner and forme following: first to draw the tropique of Cancer, set one foot of your Compasse in the Center e, and the other foote in the Meridian or line a, e, at such distance as is the greatest declination of the Sunne, which is 23 degrees, and 28 minutes, and there set downe a pricke or marke, then aswell from d, towards a, as from b, to a, count the saide greatest declination of the Sunne, which is 23 degrees, 28, and there make a marke on the innermost of the three outward Circles on both handes, that done seeke a Center vpon the extended line a, f, so as from thence you may drawe a Cirtle that may passe through the three markes last mentioned, and that shall bee the tropique of Cancer, then keeping your Compasse still at that wideness, transferre the same to the extended line c, g, setting the firme foot, so as you may drawe with the other foote another circle that is of like distance from the Equinoctiall, and that shall bee the tropique of Capricorne.

Now to draw the polar circles you must doe thus. Number vpō the first Meridian A, C, from the pole towards e, the greatest declination of the Sunne, and there make a marke, and againe from the pole vpon the innermost circle on both sides of the Meridian count the like quantitie of degrees, & marke the same quantitie vpon the first Meridian, then hauing found the Center in any of the extended lines belonging to the poles, draw a circle through those three markes, and the circle drawne towards a, shall bee the circle artique, and the other drawne towards c, with like wideness of your Compasse shall be the circle antartique, and so your carde is readie to describe therein what places you will, knowing the longitude and latitude thereof, and that the longitude doe not exceed aboue 180 degrees. And I take this forme of Card to be the

best

beſt both for ſea and land: for euery region therein deſcribed, muſt needes haue his true ſhape, ſo as you know the true longitude & latitude of the outermoſt bounds and limites thereof.

Beſides theſe manner of Maps Plancius ſetteth downe the whole earth in two ſeuerall rundles, each one containing the iuſt halfe of the earth that is to ſay, the North halfe and the South halfe making the Equinoctiall in each halfe the outermoſt circle, and the center of the North rundle ſignifieth the North pole, & the center of the South rundle ſignifieth the South pole, which manner of Mappe, becauſe I haue alreadie plainely ſet downe together with the vſe thereof in my deſcription of Plancius his vniuerſall Map, I leaue to deale any further therewith, I haue ſéne alſo many yeares ſince an vniuerſall Map made by a french man, which was round in ſhape like vnto a planiſphearc, hauing both the poles placed in the verie Center thereof, which map becauſe I cannot get here in England for any monie, I am forced to leaue vndeſcribed, and inſtead thereof, I thinke good to ſet downe here the deſcription of a verie good Map of Europe made by Mercator in the yeare of our Lord, 1554. becauſe the manner of making the ſaid Mappe doth greatly pleaſe mee.

Maister Blundeuile his description of an excellent good Mappe of Europe, made by Mercator in the yeare of our Lord, 1554. in which description is first shewed the manner of making the saide Mappe, and then the vse thereof.

FIrst he the saide Mercator considered what longitude and latitude Europe hath, & knowing partly by the ancient Tables of Ptolomie, and such others, but chiefly and most truly by the moderne Maps and Sea Cards, that Europe had in longitude no more than 70 degrées, counting from the first Meridian passing through the Iles Canarie, otherwise called Insulæ fortunatæ, vnto the Meridian which passeth through the fluud Tanais, which is the vttermost bound or limit of Europe towardes the East, deuiding the same from Asia, yet because hee thought good to set downe in his Mappe a good part of Asia, whereon Europe abutteth or bordereth towards the East: he made the said longitude in his Map to extend Eastward 100. degrées euen to the further side of the great flouu Obye, and though he founde by the aforesaid tables and sea Cardes, that the latitude of Europe was no more but 40. degrées, counting from the Paralell of 30. degrées of North latitude, vnto the Paralell of 70 degrees of North latitude, yet he maketh his Map to extend farther, as well Northward as Southward, as you may plainely see in beholding the said Card. These thinges being presupposed in the way of preamble, I will now shew you what order he obserued in making the said Card. First, hee drew a right perpendicular line through the middest of his Card, which he calleth the middle Meridian

ridian signifying the axle tree of the world, which line he extended right out a good way Northward beyond his Mappe, about the quantitie of the third part thereof, to the intent that the North end of that line signifying the North pole, might bee the center whereon hee had to drawe all his Paralels contained betwixt the 30. degrees and 70. degrees of North latitude: and for that purpose he deuided with his Compasse the middle meridian beeing so extended from the 30. Paralell to the verie Pole, into 12. equal parts or spaces, & euerie such space into 5 degrees which maketh in al 60 degrees, coũting those degrees frõ the nether end of the middle Meridian crossing the 30 Paralell vnto the foresaide Center, vpon which Center, setting the firme foote of his Compasse, and extending the other to the lower end of the said middle Meridian wheras it crosseth the 30. Paralel, he draweth his first paralell so far on both hands as his Carde will suffer him, which Paralell according to the quantitie of the space of the degrees, he draweth through the pricks of deuision set downe in the middle Meridian, the rest of the Paralels vntill hee come to the 70. degrees of North latitude, that done he deuideth as well the vpper Paralell as the nether Paralell, each of them into 20. equall parts or spaces, euery space containing 5 degrees, through which diuisions he draweth his Circular Meridians, or rather portions of circular meridians, some greater, some lesser by finding out fit centers to draw thereon the said portions of circles on both sides of the middle Meridian through 3 seuerall prickes or points, whereof one must bee alwaies that which signifieth the north Pole which is cleane without the Carde, and the other two pricks are to be sought in the two paralels that are deuided, as before each of them into 20 parts, which 2 pricks must answere one another according to the like number of degrees of the saide 2 paralels, as 10 to 10. 20 to 20 and so forth. As for example, suppose that you would draw a Meridian that may passe through the 20 section of the thirtie Paralell, and also through the twentie section of the 70 Paralell, and thirdly through the Pole: here to finde out an apt center to drawe this Meridian, it is not easie vnles you haue an Instrument meete for the purpose, like to that which Master Blagraue setteth downe in the 4. Booke of his Mathematicall Jewell Chap. 20. made according to the

doctrine

doctrine of Euclyde: for to finde out all the Centers of the saide Meridians in this little Carde according to Euclyd his rule of drawing a circle through 3 pricks, would require an euen floore almost 40 foote square.

Thus hauing drawne the Paralels and Meridians of his Card, he setteth downe therein all such notable places as are contained in Europe, as Townes, Riuers, Seas, Ilandes, Mountaines and such like, as well according to their true longitudes, and latitudes, as also according to their due direction, that is to say, how one place beareth from another, as East, West, North, or South and so forth: wherein he was greatly holpen by the sea Cards lately made by skilfull Pilots. And it seemeth by the card whereby I made this description, that Mercator had an intention to set downe in the saide Carde certaine flyes of direction to shew thereby howe euery place doth beare each one from other: which flies though they doe not all plainely appeare: yet the print of some of them is still to be séene in the said Card. I thinke that Mercator caused them to be cancelled for feare of occupying too much roome in his Carde, and thereby to hinder the view of many places needfull to be set downe in the said Carde.

Moreouer he addeth to his said Card three seuerall scales, one of latitude the second of longitude, and the third of distance: By the first you may easily find out the true latitude of any place, & by the second the true longitude of any place contained in the laide Card, and by the third scale you may know how many miles according to the diuersitie of miles in euery seuerall region one place is distant from another, the description and vse of all which three scales hereafter followeth.

The description and vse of the scale of latitude.

The scale of latitude consisteth of 4. right lines making 3. columns, euery one containing in length one such whole space, as contained betwixt any two paralels set downe in the Map, & as euery such space is diuided into 5 degrées, so likewise is the length of the scale as you may see by the number set downe in the first colume on the left hand thus 1, 2, 3, 4, 5. and euery degrée is diuided into fiue equall parts, as you may perceiue by the second colume, and euery such part is deuided into 10, as you may perceiue by the third colume, so as euery whole degree is deuided into 60. the vse of which scale is to find out the true latitude of any place contained in the Map thus.

Set the one foot of your compasse in the place whose latitude you seeke, extending the other foote to the Paralell which is next vnto that place, which paralell if it be beneath the place, then applie that wideues of your Compasse vnto the lower part of the scale, by setting the one foot therof at the lowest end of the scale, and the other foote vpward so far as the wideues will extend, thē looke how many degrées & minutes are contained betwixt the 2. feet of your Compasse, & adde that vnto the number of the aforesaid Paralel set downe in the map, and the sum therof shalbe the latitude of the place. But if you doe extend your Compasse from the place whose latitude you seeke, to the next paralell aboue it: then you must applie that wideues of your compasse to the vpper part of the scale, setting one foote of your compasse in the verie toppe thereof, and the other downeward so farre as that wideues will reach, then loke how many degrees and minutes are contained betwixt the two feete of your Compasse, & subtract that from the number of the said vpper paralell set downe in the map, and the remainer shall be the latitude of that place.

As for example, you would know the latitude of Rome, which is the chiefest Citie in Italie. Here hauing founde out Rome in the Mappe, you must first set one foot of the Compasse in that verie place, extending the other foote vnto the next inferiour

Paralel.

Paralell, that done keeping your Compasse at that widenes, applie the same vnto the Scale, by setting one foote at the lowest end of the scale, and the other vpward so farre as that wideneſſe will reach, then looke how many degrees and minutes are contained betwixt the two feete of your Compasse and you shall finde it to be one degree 48. which beeing added to the number of the foresaide next inferiour paralell, which is 40, set downe in the Map, it will make in all 41. degrées 48, and that is the latitude of Roome. But if you doe extend your Compasse from Roome to the next vpper paralel, then in applying the widenes to the scale, you must set one foote of your Compasse in the very toppe of the scale, and the other downeward, so farre as that widenes will extend, and by looking how many degrées and minutes are contained betwixt the two fét of your compasse, you shall finde them to be 3 degrees 12 minutes, which being taken from 45. which is the number of the next vpper paralell, there will remaine 41 degrees 48 as before.

Then hauing the latitude of Roome, you may easilie finde out the longitude thereof by help of the scale of longitude set downe in the map, the description and vse whereof hereafter followeth.

The description and vse of the Scale of Longitude.

THis Scale as you see cõsisteth of 30. long right lines signifying meridians, drawn frõ the left hand toward the right, whose spaces doe waxe straighter & straighter towardes the Pole, which meridians are crossed with 40 circular paralels, proceeding orderly from the 30 paralell to the 70. euery one shorter than other towards the Pole, as you may perceiue by the number set downe, as well aboue as beneath the scale, and as the first and greatest paralell on the left hand is deuided into 5. degrees, and euery degree into six partes, so is euery other paralel, be it neuer so short, the vse of which scale is thus. First hauing found the latitude of any place by help of the scale of latitude before described, you must keep your compasse still at the widnes of the latitude first foũd, & apply that same widnes vnto that meridiã which is nearest vnto the place, by setting one foot in the former paralel, wheras the next meridiã doth crosse the same, extending the other foot vpõ the said Meridian vpward,

so

so farre as that wideness will suffer, and there make a pricke, in which pricke set the one foote of your compasse, and extend the other to the place, and applie that last wideness to the scale of longitude, by setting the one foote in the neather side of the scale, at the verie latitude before found, and extend the other vppon the same parallell of latitude, so farre vpward as that wideness will suffer: then looke how many degrées and minutes are comprehended betwixt the two feet of your Compasse, and adde that to the number of the foresaid next Meridian set downe in the Mappe, and if the same Meridian bee on the left hand of the place, then it is westerly from the place, but if the next Meridian which you take bee on the right hand standing on the East side of the place, then you must subtract the degrées & minutes founde in the scale of longitude from the number of that Meridian set downe in the Map, & the remainer shall be the longitude of the place. As for example, hauing found the longitude of Rome by helpe of the scale of latitude to be 41 degrées 48 as is aforesaide, heere keping your compasse still at the former wideness, apply the same to the next Meridian on the left hand by setting one foote in that point, whereas the said Meridian crosseth the parallell of latitude, & the other foote still vpon the same Meridian vpward so farre as that wideness will extend & there make a pricke, in which prick hauing set the one foote of your compasse, extende the other foote to the place where Rome standeth: that done, applie that last wideness of your compasse vnto the neather part of the scale of longitude, by setting the one foote in the verie degrée & minute of the former found latitude, and the other foote vppon the same degrée and minute of latitude. Then looke how many degrées and minutes are comprehended betwixt the two feet of your Compasse, which you shall finde to be 1 degrée, 10. & by adding that to the number of the next Meridian on the left hand set downe in the Map, which is 35 degrées it maketh in all 36 degrees 10. & that is the longitude of Rome. But if you make choice of the next Meridian on the right hand, whose number is 40 degrees, then you must subtract the degrees & minutes contained betwixt the two feet of the compasse, which you shall finde to be 3 degrées 50. out of the next parallell on the left hande, which is 40 degrees, and there will remaine 36. degrees, 10. minutes as before.

The

The Scale of distance.

This Scale needeth no description, because it is plainely set downe in the Mappe, shewing the diuersitie of Leagues or Miles belonging to euery Nation or Region, wherefore if you would know the distance betwixt any two places set downe in the Mappe, you haue no more to doe, but to take with your Compasse the iust distance betwixt these two places, and to applie that wideneſſe to the Scale by ſetting the one foote of your Compaſſe in the beginning of thoſe Miles, that are anſwerable to the Region, or rather to thoſe kinde of Miles which you ſeeke to know, and extend the other foote vppon that part of the Scale, ſo farre as that wideneſs will ſuffer you: the number of miles comprehended betwixt the 2. feet of your compaſſe will ſhew you the true diſtance betwixt the two places. By this meanes you ſhall finde the diſtance betwixt Rome and Naples to bee 120 miles, but if the diſtance of the two places ſet down in the Mappe be longer then the ſcale it ſelfe, then you muſt firſt take the whole length of that part of the ſcale which is anſwerable to thoſe miles which you ſeeke, & by keeping your compaſſe at that wideneſs, to meaſure by a right line how many times the ſaid wideneſs is comprehended betwixt the two foreſaid places, and the number of miles ſhalbe the diſtance: but if there bee any odde meaſure: then you muſt ſtrayten your compaſſe to anſwere that od meaſure, and apply that wideneſs to the beginning of the aforeſaide ſcale, and adde that to the former number, whoſe totall ſumme ſhall be the diſtance betwixt the two places.

Moreouer you ſhall finde on the right ſide of this Mappe the peregrination of the Apoſtle S. Peter, and right vnder that the peregrination of S. Paule, ſhewing in how many places they preached the word of God, what miracles they did and where. And in the foot of the Mappe on the right hand is ſet downe the peregrination of Jeſus Chriſt, ſhewing the places where he preached or did any great miracles.

Finally

Finally about the middest of the Mappe you shall finde certaine Characters shewing which Townes are the seates of Bishops, Archbishops, Patriarkes, Popes, and such like.

And thus I end praying you to take my labour herein bestowed well in worth, which I would not haue done, but that I know this Carde to be a necessarie Carde, and to bee made with verie good Arte, according to the example of which Carde, the sonne of old Mercator hath lately put forth diuers small Cardes of Europe, traced with lines and circles like to these of his Fathers Carde, the vse of which lines and circles, I feare mee that few doe rightlie vnderstand, and for that cause I was the more willing here to set downe this plaine description of the Fathers Carde.

FINIS.